016.53
C 578
C L

SCIENCE ABSTRACTS: SECTION A 2089–2726

LUME 61

MBER 725

Y 1958

PHYSICS ABSTRACTS

Published by The Institution of Electrical Engineers

UNIVERSITY OF ILLINOIS
LIBRARY
JUN 10 1958
CHICAGO

SECTION A OF SCIENCE ABSTRACTS

Edited and issued by THE INSTITUTION OF ELECTRICAL ENGINEERS, Savoy Place, London, W.C.2 © 1958

Published monthly in association with THE PHYSICAL SOCIETY, THE INSTITUTE OF PHYSICS, THE AMERICAN PHYSICAL SOCIETY, AND THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Co-operating member of the I.C.S.U. Abstracting Board (International Council of Scientific Unions)

Physics Abstracts

	PAGE
MATHEMATICS	201
ASTRONOMY. ASTROPHYSICS	201
PHYSICS	203
Fundamentals	203
General mechanics. Mechanics of solids	208
Mechanical measurements	208
Mechanics of fluids	208
Molecular theory of liquids	209
Mechanics of gases	209
Molecular theory of gases	210
Vibrations. Acoustics	210
Optics. Radiation. Spectra	213
Heat	217
Thermodynamics	219
Electricity	219
Electrostatics. Dielectrics	219
Electric conduction. Currents	220
Electric discharges	224
X-rays	225
Cathode rays. Positive rays	225
Discharge tubes. Ionization. Thermionics	226
Cosmic rays	227
Magnetism	228
Electromagnetism. Electrodynamics	230
Electromagnetic waves and oscillators	232
Nuclear and atomic physics	233
Apparatus. Particle detectors	233
Elementary particles	234
Nucleus	240
Radioactivity	242
Nuclear reactions	244
Atoms	248
Molecules	248
Solid-state physics	251
Structure of solids	255
Elasticity. Strength. Rheology	255
PHYSICAL CHEMISTRY	257
Phase equilibrium. Chemical reactions	257
Electrochemistry	—
Photochemistry. Radiation chemistry	257
Dispersions. Colloids. Adsorption	—
Chemical structure	—
Chemical analysis	257
CRYSTALLOGRAPHY	258
X-ray crystallography	258
GEOPHYSICS	258
Atmosphere. Meteorology	258
BIOLOGY	259
Medical science. Human physiology	259
TECHNIQUE. MATERIALS	260
Photography	260

The number printed above each abstract on the right is the Universal Decimal subject classification number; the abstracts are arranged in order of these numbers throughout each issue.

The monthly Author Index, List of Journals, Errata and Notes follow immediately after the last page of abstracts.

RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Electrical and magnetic measurements and instruments	Waveguides	Oscillators. Pulse circuits
	Transistors	Amplifiers
Electronic relays and counters	Photocells	Electroacoustic apparatus
Automatic control mechanisms	Thermionic tubes	Radiocommunication
Applied electrochemistry	Cathode-ray tubes	Mechanical engineering
Lines and networks	X-ray tubes	Illumination

Committee of Management 1957–58

THE INSTITUTION OF ELECTRICAL ENGINEERS

THE PRESIDENT (*ex officio*)
L. G. BRAZIER, Ph.D., B.Sc., M.I.E.E.
J. A. BROUGHALL, B.Sc.(Eng.), M.I.E.E.
L. HARTSHORN, D.Sc., M.I.E.E.
R. L. SMITH-ROSE, C.B.E., D.Sc., Ph.D., M.I.E.E.

THE PHYSICAL SOCIETY

J. H. AWBERY, M.A., B.Sc. (*Chairman*)
W. R. S. GARTON, B.Sc.
D. ROAF, M.A., D.Phil.
MISS A. C. STICKLAND, M.Sc., Ph.D.

THE INSTITUTE OF PHYSICS

L. R. G. TRELOAR, B.Sc., Ph.D., D.Sc., F.Inst.P.

THE ROYAL SOCIETY

T. E. ALLIBONE, D.Sc., Ph.D., M.I.E.E., F.R.S.

THE CENTRAL ELECTRICITY GENERATING BOARD

H. W. GATEHOUSE, A.M.I.E.E.

OBSERVER FOR THE AMERICAN PHYSICAL SOCIETY

R. T. WEBBER, B.A., M.S., Ph.D.

Editorial

EDITOR

B. M. CROWTHER, M.A., Ph.D., F.Inst.P.

SECTION EDITOR (Electrical Engineering)

L. MacQUISTEN WALLACE, B.Sc., A.M.I.E.E., A.M.I.E.(Aust.).

ASSISTANT EDITORS (Physics)

J. R. DAY, B.Sc.
N. R. FOWLER, A.R.C.S., D.I.C., F.Inst.P.
A. TYBULEWICZ, B.Sc.

ASSISTANT EDITOR (Electrical Engineering)

R. W. PRIOR.

Annual Subscriptions

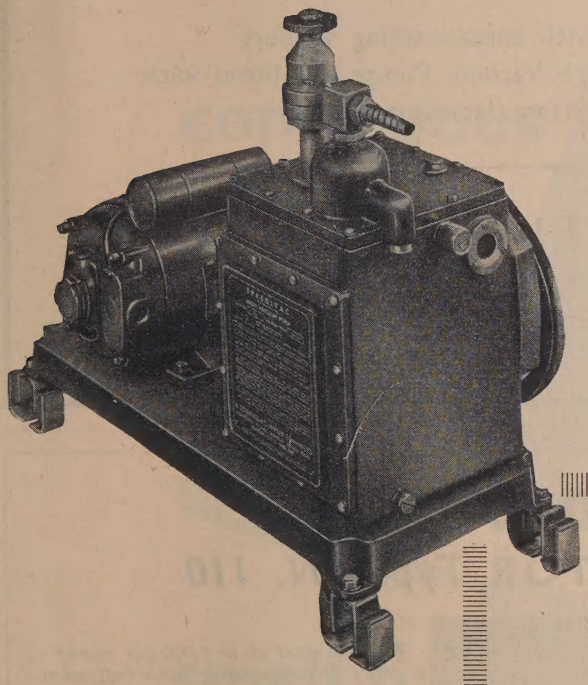
Science Abstracts is published in two sections, available separately:
Section A, *Physics Abstracts*: £6 0 0.
Section B, *Electrical Engineering Abstracts*: £5 0 0.
Both sections, £10 0 0.

Printed on one side only, for mounting on cards (indexes on request only):
Section A, £7 0 0; Section B, £6 0 0;
both sections, £12 0 0.

The Institution of Electrical Engineers, Savoy Place, London, W.C.2. Telephone: Temple Bar 7676.

Quietly . . .

THEY MEET MOISTURE CONTAMINATING CONDITIONS WITH UNFALTERING PERFORMANCE!



It is often overlooked that most vacuum systems handle wet air—the exhausted atmosphere frequently having a high natural humidity. Thus "SPEEDIVAC" pumps have a double value . . . they give the fastest vacuum pumping performance possible by a mechanical pump . . . they maintain the high vacuum performance under all kinds of conditions—handling all non-corrosive and condensable vapours—all without extra cost, and **WITHOUT A WHISPER.**

"SPEEDIVAC"
Trade Mark

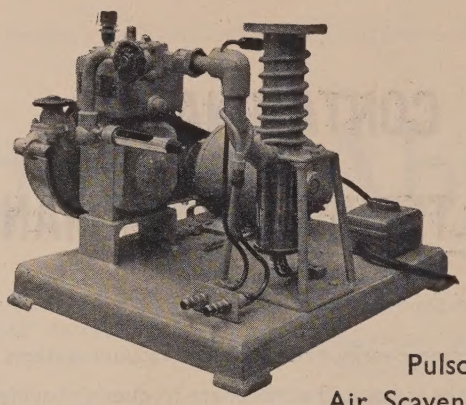
HIGH SPEED, HIGH VACUUM AIR-BALLAST ROTARY PUMPS

For better vacuum service . . .

EDWARDS HIGH VACUUM LTD

MANOR ROYAL · CRAWLEY · SUSSEX CRAWLEY 1500 (10 LINES) EDCOHIVAC CRAWLEY

COMPOSITE HIGH VACUUM SETS



Mobile and Bench Types

★

ALSO SPECIAL MODELS FOR HIGH VACUUM STERILISING

To deal with contaminating vapours Pulsometer High Vacuum Pumps are fitted with Air Scavenging and Steam Jacketing.

PULSOMETER ENGINEERING CO. LTD.

NINE ELMS IRON WORKS, READING, BERKS.

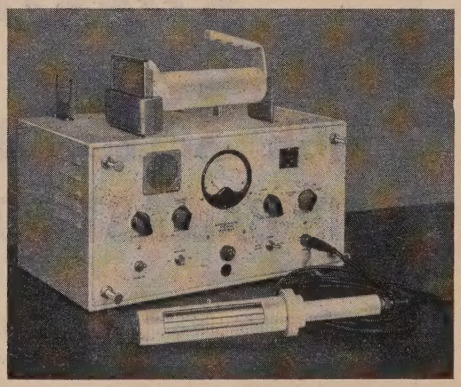
London Office: Pulsometer House, 20/26 Lamb's Conduit Street, W.C.1.

BURNDEPT

RADIATION MONITOR *Type BN. 110*

Designed primarily for measurement of radiation from contaminated apparatus or surfaces, and personnel monitoring using Alpha and Beta Gamma Probes.

Early delivery. Fullest information sent on request



- *Count rates up to 5,000 per second in four ranges using meter indication*
- *Resettable register for low count rates*
- *Incorporates stabilised E.H.T. supply for probes*
- *Large Area Alpha Probe has effective area of approximately 16 square inches*
- *Easily decontaminated and readily transportable*

CONTRACT DEPARTMENT

BURNDEPT LIMITED

ERITH, KENT

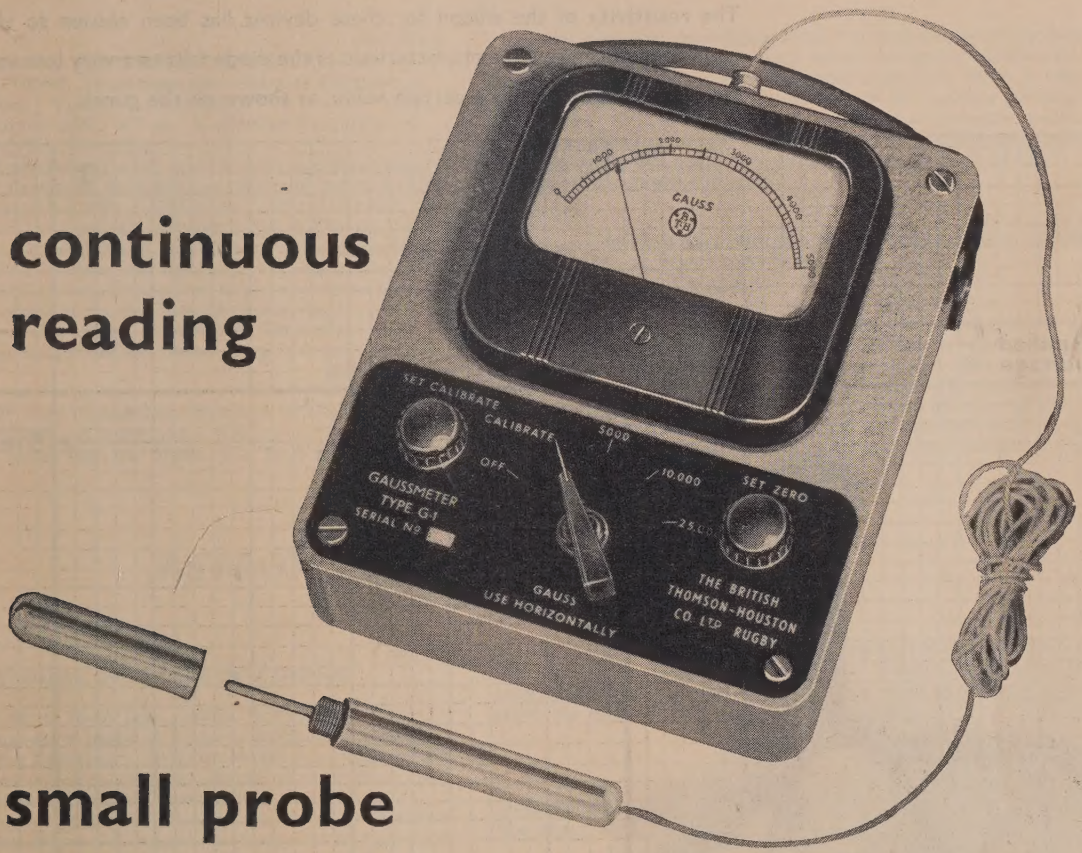
Manufacturers of

Head Amplifiers · Ratemeters · Radiation Monitors Neutron Monitors

B
T-H

GAUSSMETER

continuous reading



small probe

(CROSS SECTION 0·140″ x 0·035″)

Measurement of magnetic field strength in very narrow gaps is now possible with the BTH gaussmeter. Designed for D.C. fields from 0 to 25,000 gauss, it is robust yet light and portable. Continuous readings, not ballistic, are given; there is no disturbance of the magnetic field; and the probe cannot be damaged by magnetic overloads. No external power supply required. Especially suitable for measuring flux density in loudspeaker fields, gaps of instrument magnets and relays, D.C. machines, circuit breakers, etc.

BRITISH THOMSON-HOUSTON

THE BRITISH THOMSON-HOUSTON COMPANY LIMITED · RUGBY · ENGLAND

Member of the AEI group of companies.

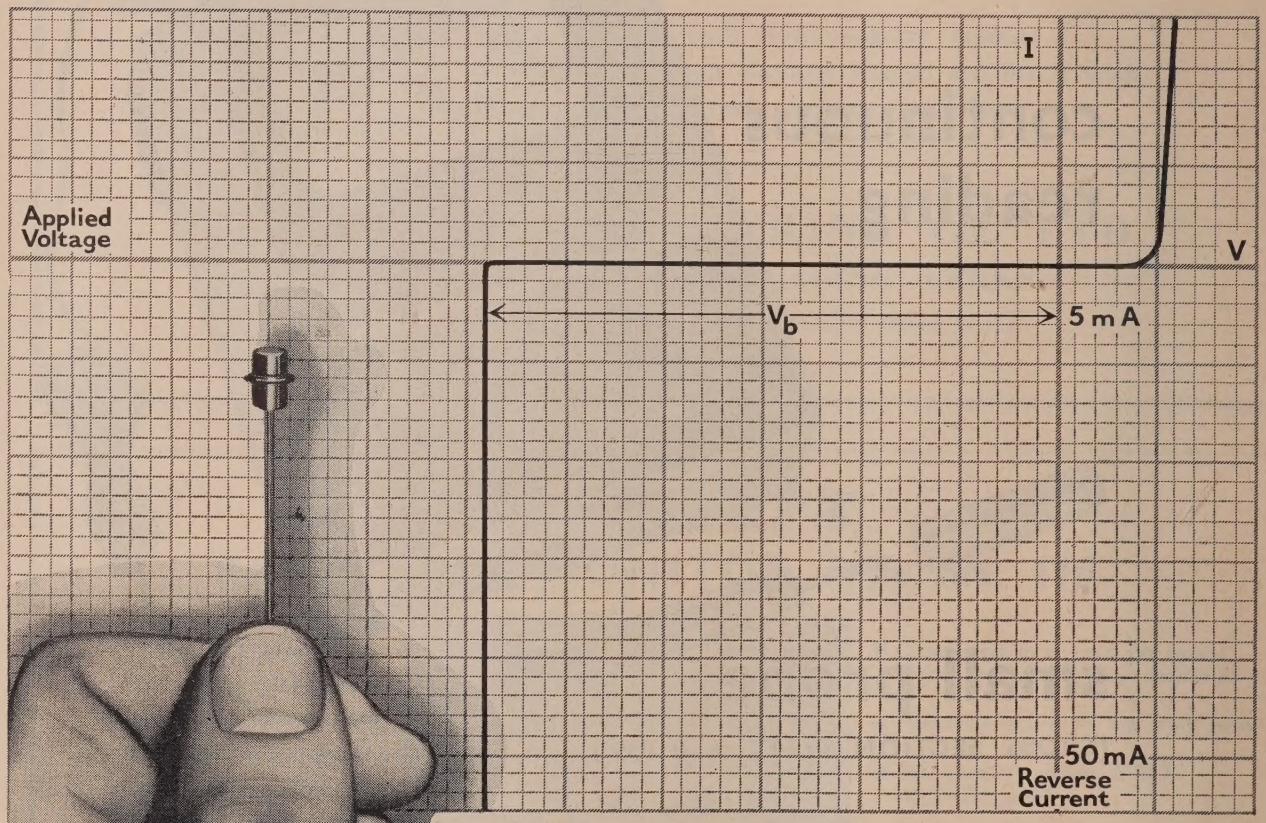
A4788

G.E.C.

silicon zener diodes

In production and immediately available

The resistivity of the silicon for these devices has been chosen so that the slope resistance of the reverse characteristic of the diode falls to a very low value when the reverse voltage exceeds a certain value, as shown on the curve.



Uses of zener diodes

- Voltage Stabilisers
- Voltage Reference Devices
- Limiters
- D.C. Coupling Elements
- Decoupling Elements

Characteristics—Stabiliser Direction		SX56	SX68
Nominal working voltage at −5 mA, V_b		5.6 V ± 10%	6.8 V ± 10%
Typical slope resistance	at −1mA	200Ω	50Ω
	at −5 mA	30Ω	10Ω
	at −20 mA	5Ω	2Ω
Typical temperature coefficient at −5 mA		± .02% per °C	+ .04% per °C − 0%
Maximum mean dissipation		at 50°C = 300 mW at 100°C = 150 mW	

Further information on these devices may be obtained from the G.E.C. Valve and Electronics Department.

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

PHYSICS ABSTRACTS

Volume 61 MAY 1958 Number 725

MATHEMATICS

517.564.4

2089. THE SPHERICAL FUNCTIONS OF LEGENDRE AND SPHEROIDAL FUNCTIONS. [Fonctions sphériques de Legendre et fonctions sphéroïdales.] Volume 1. L.Robin.
Paris: Gauthier-Villars (1957) 207 pp. [Collection Technique et Scientifique du C.N.E.T.]. In French.

Vol. 1 of this three-volume work gives a clear and systematic exposition of the properties of the Legendre functions $P_n(\mu)$, $Q_n(\mu)$ and the associated functions $P_n^m(\mu)$, $Q_n^m(\mu)$ for integral m and n, $n \geqslant 0$, $m \geqslant 0$. Particular emphasis is given to the $P_n^{-m}(\mu)$ as these also exist for $m > n$. It provides many useful formulae, especially recurrence relations and limits, and has elegant proofs of some known results. Several errors in previous works are corrected. Short tables are provided of the formulae for $P_n(\mu)$, $Q_n(\mu)$, $P_n^m(\mu)$, $Q_n^m(\mu)$, for low values of n and m. It has a detailed contents table and should prove useful to mathematicians, physicists and engineers.
M.J.Kearsley

517.6 : 539.17

2090. TABLES OF THE CLASSICAL ORBITAL INTEGRALS IN COULOMB EXCITATION. K.Alder and A.Winther.
K. Danske Vidensk. Selsk. mat-fys. Medd., Vol. 31, Paper 1, 74 pp. (1956).

In the classical description of the Coulomb excitation process one is led to some non-elementary definite integrals. These integrals can also be used in a more refined treatment, which is related to the W.B.K. method, for the calculation of the quantum mechanical corrections. This paper contains a collection of formulae, mathematical properties, and asymptotic expansions of these integrals. An explicit tabulation of the integrals for a large range of the interesting parameters is given. A.

518.5 : 519.272

2091. OPTICAL AUTOCORRELATION MEASUREMENT OF TWO-DIMENSIONAL RANDOM PATTERNS.
L.S.G.Kovásznay and A.Arman.
Rev. sci. Instrum., Vol. 28, No. 10, 793-7 (Oct., 1957).

A function of two independent variables can be regarded as an image. Using a novel optical technique, the autocorrelation coefficient of such a function is formed as another image. The working principle of the instrument is based on geometrical optics alone; however, the basic equipment was further improved by adopting electronic scanning techniques. Test plates with prescribed autocorrelation functions were made, the equipment was experimentally tested, and was found to operate to satisfaction. A.

ASTRONOMY . ASTROPHYSICS

522.41

2092. THE IMPERSONAL ASTROLABE OF A.DANJON.
B.Guinot.
Rev. Opt., Vol. 37, No. 1, 18-31 (Jan., 1958). In French.

This new instrument is based on an early design of prismatic astrolabe (Claude and Driencourt, 1900) which had two major defects, viz., a large personal error in noting the instant of coincidence of direct and reflected stellar images, and an error due to changing focal length of the convergent optical system employed. Both errors are eliminated in the Danjon instrument which employs an ingenious arrangement of birefringent prisms with micrometric adjustment.
D.R.Barber

523 : 539.12

2093. ON GAMMA-RAY ASTRONOMY. P.Morrison.
Nuovo Cimento, Vol. 7, No. 6, 858-65 (March 16, 1958).

Photons in the visible range form the basis of astronomy. They move in straight lines, which preserves source information, but they arise only very indirectly from nuclear or high-energy processes. Cosmic-ray particles, on the other hand, arise directly from high-energy processes in astronomical objects of various classes, but carry no information about source direction. Radio emissions are still more complex in origin. But γ-rays arise rather directly in nuclear or high-energy processes, and yet travel in straight lines. Processes which might give rise to continuous and discrete γ-ray spectra in astronomical objects are described, and possible source directions and intensities are estimated. Present limits are set by observations with little energy or angular discrimination; γ-ray studies made at balloon altitudes, with feasible discrimination, promise valuable information not otherwise attainable. A.

523.164 : 621.396.677

2094. THE SYDNEY 19.7 Mc RADIO TELESCOPE. C.A.Shain.
Proc. Inst. Radio Engrs, Vol. 46, No. 1, 85-8 (Jan., 1958).

The construction and operation of the "Mills Cross" radio-telescope is described briefly, with special reference to the features peculiar to operation at this low frequency. The results obtained so far are reviewed. They relate to the detection of ionized interstellar hydrogen, to the evaluation of the general background radiation from extremely distant external galaxies, to the study of discrete sources, and to the study of refraction in the ionosphere. A.

523.164 : 551.510.535

MEASUREMENTS OF HIGH-LATITUDE IONOSPHERIC ABSORPTION USING EXTRATERRESTRIAL RADIO WAVES.
See Abstr. 2073

523.164.3

2095. 18-MEGACYCLE OBSERVATIONS OF JUPITER IN 1957.
T.D.Carr, A.G.Smith, R.Pepple and C.H.Barrow.
Astrophys. J., Vol. 127, No. 2, 274-83 (March, 1958).

Systematic observations at a frequency of 18 Mc/s of the intermittent radiation emitted by Jupiter confirm the existence of several radio sources on the planet. These sources appear to be rotating with a period 11.8 seconds shorter than the period of the System II longitudes. There is evidence that the sources are relatively fixed, perhaps to the surface of the planet. There is also good evidence that Jupiter possesses an ionosphere comparable to that of the earth. A.

523.164.3

2096. OBSERVATIONS OF VENUS AT 3.15 cm WAVE LENGTH.
C.H.Mayer, T.P.McCullough and R.M.Sloanaker.
Astrophys. J., Vol. 127, No. 1, 1-10 (Jan., 1958).

The observations of radiation from Venus at 3.15 cm wavelength on 34 days in May-June, 1956, are described. The apparent black-body temperature for Venus derived from the measurements changed from about $620^\circ \pm 110^\circ$ K (m.e.) in early May to about $560^\circ \pm 73^\circ$K (m.e.) near inferior conjunction. Two single observations at 9.4 cm wavelength are described, which suggest that the radiation follows a thermal spectrum. A.

523.164.3

2097. OBSERVATIONS OF MARS AND JUPITER AT A WAVE LENGTH OF 3.15 cm.
C.H.Mayer, T.P.McCullough and R.M.Sloanaker.
Astrophys. J., Vol. 127, No. 1, 11-16 (Jan., 1958).

A number of observations of Mars were made with the Naval Research Laboratory 50 foot reflector at a 3.15 cm wavelength during September, 1956, when the planet was near opposition. Of these, 71 observations were selected for a quantitative reduction, which yielded a black-body temperature for Mars of $218^{\circ} \pm 76^{\circ}$K (m.e.). Twenty-nine observations of Jupiter were made with the same apparatus in May, 1956. A black-body temperature of $140^{\circ} \pm 56^{\circ}$K (m.e.) was found from these data. Further observations of improved accuracy were made in March, 1957, when Jupiter was near opposition. A quantitative reduction of the average of 45 of these observations gave a black-body temperature for Jupiter at the 3.15 cm wavelength of $145^{\circ} \pm 26^{\circ}$K (m.e.). A.

523.164.32 : 523.755

2098. ON THE RADIO-EMISSION OF CORONAL CONDENSATIONS.
V.V.Vitkevich and M.I.Sigal.
Astron. Zh., Vol. 34, No. 5, 716-23 (1957). In Russian, with summary in English.

An attempt is made to correlate the position of the effective centre of solar radio-emission at 10 and 50 cm with the coronal disturbances in the green line λ5303 A. S.Chomet

523.164.32 : 523.755

2099. A REMARKABLE SOLAR RADIO EVENT.
Nature (London), Vol. 181, 542-3 (Feb. 22, 1958).

This paper comes from the staff of the Ionosphere and Radio-astronomy Section of the Netherlands Telecommunications Services, The Hague. A large increase in solar radio noise at 200 Mc/s was observed at the Netherlands Telecommunications Services Observatory on 4th November, 1957, which is uncorrelated with any solar flare or S.I.D. observations. It was also observed elsewhere in the metre waveband, but was absent in the decimetre/centimetre bands. High-speed recording revealed short-period fluctuations reminiscent of ionospheric scintillations of radio-sources. The occurrence is considered very rare, and it is suggested that the fluctuations may arise from irregularities in the solar coronal gas. G.M.Brown

523.164.32 : 621.317.35

2100. A DYNAMIC SPECTRUM ANALYZER FOR SOLAR STUDIES.
J.Goodman and M.Lebenbaum.
Proc. Inst. Radio Engrs, Vol. 46, No. 1, 132-5 (Jan., 1958).

523.164.4 : 551.510.535

USE OF RADIO STARS TO STUDY IRREGULAR REFRACTION OF RADIO WAVES IN THE IONOSPHERE. See Abstr. 2071

523.164.4 : 551.510.535

INVESTIGATION OF THE PERTURBATIONS IMPOSED UPON RADIO WAVES PENETRATING THE IONOSPHERE. See Abstr. 2072

523.164.8 : 551.594.52

DETERMINATION OF AURORAL HEIGHT BY RADAR. See Abstr. 2076

523.164.85 : 523.531

2101. A RADIO ECHO SURVEY OF SPORADIC METEOR RADIANTS. G.S.Hawkins.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 1, 92-104 (1956).

Radio-echoes have been observed in two narrow-beam aerials over the period October 1949 to September 1951. An analysis of the hourly rate of echoes has given a measure of the radiant points of sporadic meteors. The radiants are found to be concentrated towards the plane of the ecliptic in the directions of the apex, sun and antihelion points. The majority of meteors in space are moving in direct orbits about the sun, and there is a dense complex of orbits in the region traversed by the earth during the months May to August. A.

523.4 : 532.5 : 536.253

2102. PLANETARY ATMOSPHERES AND CONVECTION IN ROTATING FLUIDS. T.V.Davies.
Nature (London), Vol. 180, 1455-61 (Dec. 28, 1957). Also in: Observatory, Vol. 77, 172-86 (Oct., 1957).

Report of a joint conference held by the Royal Meteorological Society and the Royal Astronomical Society at Burlington House, London, on May 23 and 24, 1957. Papers were presented on the indicated topics: Z.Kopal, The basic observational data on planetary atmospheres; P.A.Sheppard, The general circulation of the Earth's atmosphere; H.U.Sverdrup, The circulation of the oceans; E.Lorenz, The circulation of the atmospheres of the outer planets; R.Hide, Experiments on convection in rotating liquids; R.M.Goody, The thermal structure of Mars; H.C.Urey, The escape of planetary atmospheres; R.C.Sutliffe, The influence of condensation on planetary atmospheres; J.S.Sawyer, Jet streams as a feature of the Earth's atmosphere; T.V.Davies, Theory of the experiments on convection in rotating liquids; J.G.Charney, Theory of the general circulation of the atmosphere; E.T.Eady, The physical parameters characterizing the dynamics of planetary atmospheres. Full reports of these papers will appear in the journals of the respective societies. T.W.Olle

523.51

2103. RADIATION AGE OF A METEORITE FROM COSMIC-RAY-PRODUCED He^3 AND H^3.
F.Begemann, J.Geiss and D.C.Hess.
Phys. Rev., Vol. 107, No. 2, 540-2 (July 15, 1957).

The tritium and He^3 contents of the Norton County stone meteorite were measured. At the time of fall (1948) the tritium activity of two different specimens were (0.28 ± 0.02) and (0.25 ± ± 0.02) disintegrations $min^{-1}g^{-1}$. The measured He^3 contents per gramme were (2.27 ± 0.11) and (2.35 ± 0.11) × 10^{-6} cm^3 S.T.P. respectively. Experiments were made which indicate that there has been no appreciable loss of He^3. The amount of He^3 accumulated and the tritium production rate combined give apparent He^3–He^3 ages for irradiation of 420 and 480 million years respectively. If an assumption is made as to the direct production rate of He^3 by spallation, these ages reduce to 240 and 280 million years. The $A^{40}-K^{40}$ age of this meteorite is 4400^{+640}_{-740} million years. The possible significance of this difference in age is discussed. A.

523.745 : 551.510.535 : 621.396.8

2104. SOLAR ACTIVITY AND THE IONOSPHERE. C.M.Minnis.
Nature (London), Vol. 181, 543-4 (Feb. 22, 1958).

A note, pointing out that the level of solar activity reached in the months of September, October and November, 1957, was exceptionally high, giving rise to many cases of abnormal radiowave propagation via the F2-layer (rather than the Es-layer) in the v.h.f. band. G.M.Brown

523.75

2105. SOME RESULTS OF STUDIES OF NON-STATIONARY PROCESSES ON THE SUN. A.B.Severnyĭ.
Astron. Zh., Vol. 34, No. 5, 684-93 (1957). In Russian, with summary in English.

Results of spectroscopic studies of non-stationary processes on the sun obtained during the past four years are summarized and discussed. It is suggested that the continuous non-stationary emission may be due to relativistic electrons having an energy spectrum of the form $dN(E) \propto dE/E$. Spectroscopic studies of the hydrogen spectrum of flares lead the authors to the conclusion that there should exist an energy source producing about 500 $ergs.cm^{-3}.sec^{-1}$ to support the flares. It is shown that electromagnetic heating and the penetration of coronal matter into the flares cannot provide the necessary energy. It is suggested that the sources of energy in non-stationary processes are high-energy particles. It is also suggested that some kind of cyclotron acceleration of particles may be taking place and the possibility of an inverse pinch effect is mentioned. S.Chomet

523.77 : 530.12

2106. ON THE GENERAL RED-SHIFT OF LINES IN THE SOLAR SPECTRUM. E.Finlay-Freundlich.
Ann. Phys. (Paris), Vol. 2, No. 11-12, 765-77 (Nov.-Dec., 1957). In French.

A critical review of early, and recent investigations made with the object of proving, or disproving, the existence of a general displacement of solar lines (the red-shift) predicted by the general theory of relativity. It is concluded that a definite answer to the question must await the acquisition of more detailed, and more accurate data derived from centre-to-limb observations of a large number of different lines whose excitation potentials are well determined. D.R.Barber

523.774

2107. THE DECREASE IN BRIGHTNESS OF THE SOLAR DISK FROM THE CENTRE TO THE LIMB IN THE SPECTRAL REGION 1-4 μ. N.I.Kozhevnikov.
Astron. Zh., Vol. 34, No. 6, 883-6 (1957). In Russian with summary in English.

Agreement with the results of Pierce et al. (Astrophys. J., Vol. 112, 289, 1950) is reported. S.Chomet

523.774

2108. SPECTROPHOTOMETRY OF SUNSPOTS. DETERMINATION OF EXCITATION TEMPERATURE. G.Laborde.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2009-10 (Dec. 4, 1957). In French.

Excitation temperatures in spot, and surrounding photosphere have been evaluated from spectrophotometric measures of the 0–0 vibrational bands of C_2, (5165 A), and MgH, (5211 A). The C_2 results give $T_{spot} = 3520 \pm 300^{\circ}K$, and $T_{photosphere} = 4880 \pm 350^{\circ}K$, corresponding values for MgH being $3640 \pm 300^{\circ}K$, and $4520 \pm 370^{\circ}K$. These results agree with those found previously (Adams, 1938; Hunaerts, 1947). D.R.Barber

523.774

2109. AN ATTEMPT TO DETECT DEUTERIUM IN THE SOLAR ATMOSPHERE. T.D.Kinman.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 1, 77-87 (1956).

A search was made for the λ 6561.023 deuterium line in eight centre and limb spectra of the sun using an interferometer with a resolving power of 1.2×10^5. Near this wavelength there are two atmospheric water vapour lines at λ 6560.562 and λ 6561.097, the former of which is shown to be blended with a weak solar line at λ 6560.596. An analysis of the line λ 6561.097 for centre, East and West limbs yields equivalent widths of the deuterium line of 0.0 ± 1.1, 0.03 ± 0.5, 0.09 ± 0.7 mA respectively. There is, therefore, no evidence for deuterium on the sun. The observational errors, however, are such that a weak line of equivalent width 1.1 mA (corresponding to $H^2/H^1 = 4 \times 10^{-5}$) might remain undetected. De Jager's claim to have detected a line of 6 mA was based on a single centre spectrum from which sufficient photometric accuracy could not be obtained. A.

523.775

2110. CLASSIFICATION OF EMISSION LINES OF SOLAR CORONA. A.Dollfus.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2011-12 (Dec. 4, 1957). In French.

From spectroscopic observations made either during eclipses, or with the coronagraph, at least 28 coronal emission lines have been discovered. Of these, 25 important lines are tabulated and grouped under four headings, the mean ionization potential increasing for each group. D.R.Barber

523.78 : 551.510.535

IONOSPHERIC RECORDS OF SOLAR ECLIPSES. See Abstr. 2068

523.872

2111. THE NON-THERMAL COMPONENT IN THE RADIATION FROM NON-STATIONARY STARS AND THE MAIN PROPERTIES OF THEIR SPECTRA. I.M.Gordon.
Astron. Zh., Vol. 34, No. 5, 739-54 (1957). In Russian with summary in French.

The evidence for the presence of a non-thermal component in the radiation from novae is summarized. It is shown that strong non-thermal emission can lead to a redistribution of atoms with respect to their excited states, and conversion of absorption lines into emission lines. The effect of the "coefficient of non-thermal excess" introduced earlier by the present author on the nature of stellar spectra is considered. S.Chomet

523.875

2112. ON THE INTERPRETATION OF THE EMISSION SPECTRUM OF LONG-PERIOD VARIABLE STARS. I. V.G.Gorbatskiĭ.
Astron. Zh., Vol. 34, No. 6, 860-7 (1957). In Russian, with summary in English.

It is shown that the appearance of bright lines of metals in the spectra of these stars, and the decrease in the optical thickness of the absorbing layer, may be explained by the ionization of atoms of metals in this layer by L_α radiation, emitted by lower layers of the atmosphere, and their subsequent recombination. S.Chomet

523.877 : 539.17

2113. NUCLEAR REACTIONS WITH THE NEON ISOTOPES IN STARS. J.B.Marion and W.A.Fowler.
Astrophys. J., Vol. 125, No. 1, 221-32 (Jan., 1957).

New calculations, based on recent experimental information, are made of the reaction rates of $Ne^{20}(p, \gamma)Na^{21}$, $Ne^{21}(p, \gamma)Na^{22}$, $Ne^{22}(p, \gamma)Na^{23}$, and $Ne^{21}(\alpha, n)Mg^{24}$ reactions as a function of stellar temperature. A method of obtaining the reduced nucleon widths of mirror levels is given which is probably accurate to within a factor of 2 and is used in the calculation of $Ne^{20}(p, \gamma)Na^{21}$ reaction rate. The results of these computations indicate that appreciable quantities of Ne^{21}, formed by the reactions $Ne^{20}(p, \gamma)Na^{21}(\beta^+)Ne^{21}$, cannot be produced in the presence of carbon and nitrogen, since these latter elements convert all the hydrogen into helium before the slower $Ne^{20}(p, \gamma)Na^{21}$ reaction can take place. It appears, however, that in red giant stars in which O^{16} and Ne^{20} but not C^{12} are originally present in the envelope, Ne^{21} may be formed in sufficient amounts to allow the $Ne^{21}(\alpha, n)Mg^{24}$ reaction to be the source of an adequate number of neutrons for heavy-element synthesis as the helium-burning core develops. Further experimental measurements on the $O^{16}(p, \gamma)F^{17}$ reaction and on various helium interactions will be required to settle the matter. A.

523.877 : 539.165

B^{12}, C^{12}, AND THE RED GIANTS. See Abstr. 1924

525.3 : 523.164.8

2114. RADIO OBSERVATIONS ON THE RUSSIAN SATELLITES.
Proc. Instn Elect. Engrs, Vol. 105B, 81-114 (March, 1958).

A discussion, consisting of ten short papers, on the same subjects as Abstr. 1457-66 (1958). For abstracts see Section B, Abstr. 2259-69 (1958).

PHYSICS

FUNDAMENTALS

53.081.6

2115. NEW PHYSICAL CONSTANTS FROM DIMENSIONAL ANALYSIS. A.T.Gresky.
J. Franklin Inst., Vol. 265, No. 2, 85-95 (Feb., 1958).

A specific form of dimensional analysis has been employed to show that the electromagnetic gauss unit (for intensity of magnetization) is equivalent to a simple c.g.s. quantity of 1.759×10^7 sec^{-1}. Then, considering equivalences for known intensities of magnetization of the earth and certain stars in the hypothesis of P.M.S.Blackett (concerning the magnetic fields of massive rotating bodies), it is concluded from the dimensional method that $\mu_b = 1.295 \times 10^{-8}$ cm/g is a valid constant of astronomy and classical mechanics. Further, it has been noted that the two quantities $G\mu_b^{-2}$ and $m_e^2 c^3 \hbar^{-1} \alpha_e^{-2}$ were each equal to the same quantity, $F_g = 3.978 \times 10^8$ g.cm.sec^{-2}, signifying phenomenologic interrelationships among electromagnetic, quantum, and classical physics. From this it has then been concluded that another quantity $M_s = m_e \alpha_e^{-1} = 1.248 \times 10^{-25}$ g may represent a general constant of all submicroscopic physics. Thus, the three quantities μ_b, M_s, and F_g are suggested as new physical constants. As formulated, the latter quantity F_g appears to correlate the mechanical and magnetic phenomena of either astronomic or submicroscopic particles and media; therefore, it is proposed as a broadly applicable constant of nature. A.

530.12

2116. THE EQUATIONS OF MOTION IN THE UNITARY THEORY OF EINSTEIN–SCHRÖDINGER. W.B.Bonnor.
Ann. Inst. Poincaré, Vol. 15, No. 3, 133-45 (1957). In French.

The unified field equations of Einstein–Schrödinger may be obtained by applying the variational principle to a certain function under a subsidiary condition. Here an additional term added to this function results in a modified set of field equations. The new current equation possesses a spherically symmetric solution in which the charge density has a factor exponentially decreasing with distance, so that the total charge remains finite. Using the approximation method of Einstein, Infeld and de Hoffmann, the equations of motion to fourth-order approximation give Coulomb forces between particles. The equations, however, involve an undetermined parameter and attempts to find a solution with a possible connection between mass and charge density are not successful; the unsatisfactory features are discussed in detail. M.J.Kearsley

530.12

2117. ON THE GENERALIZATION OF SCHWARZSCHILD'S PROBLEM. T.T.Vescan.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2014-16 (Dec. 4, 1957).
In French.

A discussion of the integrals of the modified field equations $R_{ik} = K(r)T_{ik}$ for a metric of the form $ds^2 = (c^2 - 2W)dt^2 - r^3d\theta^2 - dr^2$. R.A.Newing

530.12

2118. ON THE RELATIVISTIC FIELD OF A MATERIAL SPHERE OF VARIABLE DENSITY. J.Gottlieb.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2016-18 (Dec. 4, 1957).
In French.

The interior field intensity is calculated for a sphere of radius R when the density at a distance r from the centre is $\rho_0(R^2 - \beta r^2)/R^2$. R.A.Newing

530.12

2119. ON THE DISCONTINUITIES OF THE SECOND DERIVATIVES OF THE GRAVITATIONAL POTENTIALS. L.Bel.
C.R. Acad. Sci. (Paris), Vol. 245, No. 26, 2482-5 (Dec. 23, 1957).
In French.

The parameters of discontinuity $l_{\alpha\beta}$ are defined and their transformation properties studied. Restricting them by the conditions of compatibility deduced from the field equations in general relativity, it is shown that the eigenvalues of the matrix $(l_{\alpha\beta})$ are all real. A connection obtained between the $l_{\alpha\beta}$ and certain orthogonal unit vectors agrees with Pirani's result on the discontinuities of the curvature tensor. Expressions are also obtained for the discontinuity parameters in the theory of Jordan–Thiry. M.J.Kearsley

530.12

2120. ON THE METHOD OF SINGULARITIES IN GENERAL RELATIVITY. Pham Tan Hoang.
C.R. Acad. Sci. (Paris), Vol. 246, No. 1, 61-4 (Jan. 6, 1958).
In French.

As the isothermic conditions can be simply expressed in terms of the tensor densities $\mathfrak{g}^{\alpha\beta} = \sqrt{-g}.g^{\alpha\beta}$ and the Einstein tensor $S^{\alpha\beta}$ involves their second derivatives, the $\mathfrak{g}^{\alpha\beta}$ are taken as field variables. Expanding the potentials in powers of $1/c^2$ (c = velocity of light in vacuo), the equations of motion can be expressed in the form $\sigma^\alpha = 0$, where σ^α is the flux of a contravariant vector S^α defined by $S^{\alpha\beta}$ on a section of space. As an illustration of the method the equations of motion are found for a system of particles represented by point singularities of the field. M.J.Kearsley

530.12 : 538.3

2121. A THEORY OF GRAVITATION AND ELECTROMAGNETISM. K.A.Hämeen-Anttila.
Comment. phys.-math. (Helsinki), Vol. 20, Paper 4, 50 pp. (1957).
In German.

Electric charge and gravitational mass are regarded as relative quantities forming a 2-vector $M = \{ie,m\}$ which transforms so that the scalar product (MM') is invariant. A corresponding 2-vector density $S = \{i\sigma, \rho\}$ is introduced in the case of a continuous distribution of charge and matter. The inertial mass of a particle is defined to be $m_i = k(M[M_0-M])$, where M_0 is the charge–mass 2-vector for the whole universe and k is a universal constant. The summation law for inertial mass is taken to be $m_i = \sum_n m_{ni} - \sum_{n\neq s} (M_n M_s)$. These conceptions are used to generalize the electromagnetic equations in Minkowski space–time, the resulting equations describing a combined electromagnetic and gravitational field. The equations are applied to the motion of a test particle in a central field; when applied to the hydrogen atom, Sommerfeld's results follow, but when applied to planetary motion, the equations give a perihelion displacement equal to one sixth of the value derived from general relativity. R.A.Newing

530.12

2122. A REMARK ON THE PAPER "GRAVITATIONAL MOTION AND HAMILTON'S PRINCIPLE". B.Bertotti.
Nuovo Cimento, Vol. 6, No. 3, 755-6 (Sept., 1957).

A criticism of a previous paper (Bertotti, Abstr. 5674/1956) is discussed, and a fuller explanation is given of the motion of a test-particle in a gravitational field. G.Stephenson

530.12

2123. RELATIVITY IN STATIC SPHERICAL AND ELLIPTIC SPACE (EINSTEIN'S UNIVERSE). J.Kronsbein.
Phys. Rev., Vol. 109, No. 5, 1815-22 (March 1, 1958).

The Einstein model of the universe is treated by a method that accentuates its structure in-the-large, and indicates several ways of establishing homomorphism of the associated group of space-time transformations with the Lorentz group. It is also shown that there exists a subgroup of the entire space-time group which is isomorphic with the Lorentz group. A.

530.12

2124. ON THE DEDUCTION OF THE LORENTZ–EINSTEIN TRANSFORMATION FROM MAXWELL'S ELECTROMAGNETIC FIELD EQUATIONS. K.Stiegler.
Proc. Phys. Soc., Vol. 71, Pt 3, 512-13 (March, 1958).

Using the principle of special relativity and the linearity of space-time transformations, the Lorentz transformations are derived from Maxwell's equations. The invariance of the velocity of light is also shown. G.Stephenson

530.12

2125. AN INVARIANT GRAVITATIONAL DENSITY. J.L.Synge.
Proc. Roy. Irish Acad. A, Vol. 58, No. 4, 29-39, (Oct., 1957).

A non-negative invariant $H(\Lambda)$, quadratic in the curvature tensor and biquadratic in the components of a time-like unit vector Λ^r, is introduced such that $H(\Lambda) = 0$ at an event E implies zero gravitational field at E. R.A.Newing

530.12 : 523.11

2126. PRINCIPLE OF EQUIVALENCE AND THE WEAK INTERACTIONS. R.H.Dicke.
Rev. mod. Phys., Vol. 29, No. 3, 355-62 (July, 1957).

The physical consequences of the time variation of the coupling coefficients of Fermi and gravitational interactions are considered with special reference to the thermal history of the earth and the structure of the moon. It is concluded that the evidence reviewed does not exclude the possibility of such temporal variation. R.A.Newing

530.12

2127. GRAVITATION WITHOUT A PRINCIPLE OF EQUIVALENCE. R.H.Dicke.
Rev. mod. Phys., Vol. 29, No. 3, 363-76 (July, 1957).

A scalar field theory is developed based on a flat space-time metric and local Lorentz covariance. The vacuum is regarded as a dielectric medium in which the velocity of light is equal to the reciprocal of the dielectric constant ϵ, the gravitational field being determined by the gradient of ϵ. Characteristic atomic lengths, frequencies and energies are affected by variations in ϵ, but parameters associated with strong interactions remain constant. Atomic units give a Riemannian metric, but a special Newtonian frame is introduced based on Mach's principle and on a cosmological principle. Field equations are derived from a variational principle with Lorentz-invariant Lagrange density, the velocity of light being replaced by the scalar ϵ^{-1}. The theory is consistent with Dirac's cosmology. R.A.Newing

530.12

2128. NEGATIVE MASS IN GENERAL RELATIVITY. H.Bondi.
Rev. mod. Phys., Vol. 29, No. 3, 423-6 (July, 1957).

Three types of mass are distinguished: (i) inertial, (ii) active gravitational (the source of the field), and (iii) passive gravitational (the mass on which the field acts). It is noted that for the two-body problem with masses of opposite sign, one body would be attracted to the other, and the other repelled. An attempt is made to construct relativistic model for this situation and a nonsingular solution of the field equations is derived corresponding to two oppositely accelerated pairs of bodies, each pair consisting of a positive and a negative mass. R.A.Newing

530.12 : 523.77

ON THE GENERAL RED-SHIFT OF LINES IN THE SOLAR SPECTRUM. See Abstr. 2106

530.145

2129. RELATIVISTIC HYDRODYNAMICS OF ROTATING FLUID MASSES. D.Bohm and J.P.Vigier.
Phys. Rev., Vol. 109, No. 6, 1882-91 (March 15, 1958).

With the aid of the new notion of centre of matter density, a relativistic treatment is given of the behaviour of finite-size masses of rotating fluid. This treatment is based on an analysis of the relative motion of this centre of matter density and the more familiar centre-of-mass. In this way, a clear physical interpretation is obtained of the equations studied by Mathisson, Weysenhoff, and Möller. It is also shown that more general types of motions are possible, related to additional degrees of freedom of the relativistic fluid droplet. These degrees of freedom provide a framework for a theory of the quantum numbers of the elementary particles (isotopic spin, strangeness, etc.) which is to be developed in a subsequent paper. A.

530.145

2130. ON THE MOTION OF THE RELATIVISTIC FLUID OF BOHM AND VIGIER. F.Halbwachs.
C.R.Acad. Sci. (Paris), Vol. 245, No. 16, 1298-301 (Oct. 14, 1957). In French.

See preceding abstract.

530.145

2131. STUDY OF THE BOHM–VIGIER FLUID IN RELATION TO THE HYDRODYNAMIC FORMALISM OF DIRAC–TAKABAYASI. F.Halbwachs.
C.R. Acad. Sci. (Paris), Vol. 245, No. 17, 1392-4 (Oct. 21, 1957). In French.

See preceding abstract.

530.145

2132. A PARTICULAR CASE OF THE MOTION OF THE BOHM–VIGIER FLUID. F.Halbwachs.
C.R. Acad. Sci. (Paris), Vol. 245, No. 18, 1513-16 (Oct. 28, 1957). In French.

A particular case of the fluid motion (preceding abstract and also Abstr. 5054/1957) leads to a generalized motion of the Weyssenhoff fluid. G.Stephenson

530.145

2133. RELATIVISTIC INVARIANCE AND QUANTUM PHENOMENA. E.P.Wigner.
Rev. mod. Phys., Vol. 29, No. 3, 255-68 (July, 1957).

An instructive consideration of the intrinsic difference between the states of polarization of particles with and without mass, and the interpretation of the important cobalt experiment in terms of CP invariance, as suggested by Salam and by Landau, is followed by an analysis which shows up the unsatisfactory situation arising from treating in quantum theory the coordinates as observables, in the face of the basic observation of general relativity that they cannot be significant. W.A.Hepner

530.145

2134. QUANTUM THEORY OF FIELDS AND ELEMENTARY PARTICLES. W.Heisenberg.
Rev. mod. Phys., Vol. 29, No. 3, 269-78 (July, 1957).

This is a survey of papers and a general discussion of the problems arising from the author's attempt to describe all particles and their interactions with the help of one self-interacting spinor field. (For the particular model considered the non-linear interaction term is the contraction of two scalars). Although the quantization of such an equation makes the metric of the Hilbert space indefinite and would therefore, with the conventional interpretation, lead to negative probabilities, it can be shown that the new "ghost' states do not destroy the unitarity of the S-matrix. Using the "new Tamm–Dancoff" method, the lowest mass eigenvalues calculated for this model are those of a fermion and four much lighter bosons, the mass ratio ranging very roughly from 0.5 to 0.05. In addition, there are bosons of zero mass (photons) which produce a long-range interaction between two fermions; this leads to a predicted value of the fine-structure constant of about half the actual value. With this particular model it is still necessary to introduce the isotopic spin explicitly, and this can be done so as to lead to the empirical selection rules, including the conservation of baryons and strangeness. However, while the theory modified in this way is successful in predicting the non-conservation of parity in weak interactions, the particular model considered does not yet seem to lead to selection rules for transitions into leptons. W.A.Hepner

530.145

2135. A REMARK ON A PAPER BY BARAŠENKOV. C.Hayashi.
Nuovo Cimento, Vol. 7, No. 1, 116-17 (Jan. 1, 1958).

It is pointed out that Barashenkov's remark (Abstr. 8383/1957) that the integrability condition is not satisfied in the author's Hamiltonian formulation of quantized fields with a non-local interaction (Hayashi, Abstr. 5277, 9933/1954) is erroneous. W.A.Hepner

530.145

2136. ON THE VALIDITY OF LEVISON'S THEOREM FOR NON-LOCAL INTERACTIONS. A.Martin.
Nuovo Cimento, Vol. 7, No. 5, 607-27 (March 1, 1958).

By introduction of an artificial boundary condition on the one dimensional S wave-function it is possible to compare the number of eigenstates of a non-local Hamiltonian to the number of free eigenstates, provided the free and interacting eigenstates tend to coincide at high energies. Orthogonality of the wave-functions, plus certain auxiliary hypotheses, enable one to prove the inequality $\delta(0) - \delta(\infty) \geq \nu\pi$, where ν is the number of bound states. At first sight, the completeness of the eigenstates of the non-local Hamiltonian, which is proved for well behaved interactions, seems to be sufficient to establish the inequality $\delta(0) - \delta(\infty) \leq \nu\pi$ and, by comparison with the previous inequality, the theorem of Levinson, which says that the difference $\delta(0) - \delta(\infty)$ is equal to π times the number of bound states. However, one must take into account a possible degeneracy of the wave-function for a positive energy. This fact, which never happens with a local regular potential, slightly modifies Levinson's theorem. It turns out that the difference $\delta(0) - \delta(\infty)$ is equal to π times the total number of eigenstates with vanishing asymptotic form, among which some states may have a positive energy. Application of these results to the Low equation is discussed. A.

530.145

2137. MASS REVERSAL AND WEAK INTERACTIONS. J.J.Sakurai.
Nuovo Cimento, Vol. 7, No. 5, 649-60 (March 1, 1958).

An attempt is made to construct a theory of all weak processes from a single invariance principle. The requirement that the weak interaction Hamiltonian be invariant under the reversal of the sign of the mass in the Dirac equation separately for any fermion field leads to a unique form of the four-fermion interaction responsible for weak processes. The Hamiltonian contains equal amounts of V and A, and is necessarily invariant under time reversal but non-invariant under parity regardless of whether or not the neutrino field is involved. (These results are identical to those obtained by Feynman and Gell-Mann and by Sudarshan and Marshak using somewhat different approaches). The possible existence of an intermediate charged boson field responsible for all weak processes is discussed with reference to several weak processes which have not been observed. Most experiments in β-decay and the $\pi-\mu-e$ sequence are consistent with the predictions of this theory with the important exception of the He^6 recoil experiment. Various implications of the theory which can be experimentally tested are examined with special attention to the decay interactions of hyperons and K-mesons. A.

530.145

2138. AN ANALYSIS OF THE STRONG INTERACTION DATA. P.T.Matthews and A.Salam.
Nuovo Cimento, Vol. 7, No. 6, 789-93 (March 16, 1958).

An analysis is made of the data on strong interactions based on considerations of phase space and an estimate of matrix elements based on perturbation theory. A consistent picture is obtained for a scalar K-meson with all coupling constants of the order of unity. A.

530.145 : 539.165.2

2139. ON THE LOCALITY OF THE β-INTERACTION. G.F.Dell'Antonio and P.Gulmanelli.
Nuovo Cimento, Vol. 7, No. 2, 266-8 (Jan. 16, 1958).

An attempt to cancel divergences due to a Fermi interaction by means of counter terms leads to an infinite series in derivatives of the δ-function, which is equivalent to a non-local interaction. J.C.Taylor

530.145

2140. RADIATIVE MESON–NUCLEON SCATTERING. R.E.Cutkosky.
Phys. Rev., Vol. 109, No. 1, 209-17 (Jan. 1, 1958).

The static-source model of the pion–nucleon interaction is applied to the problem of the bremsstrahlung emitted in pion–nucleon scattering. It is shown that the matrix element for radiative meson scattering can be expressed in terms of other experimentally determined quantities, such as the matrix element for elastic scattering, provided the general static-source model is valid. Therefore, comparison of experimental results with those predicted by the present investigation will indicate the extent to which this simple model is valid, and suggest the refinements which are needed. A.

530.145 : 539.165.2

2141. PERMUTATION SYMMETRIES OF GENERALIZED BETA INTERACTIONS. R.Finkelstein.
Phys. Rev., Vol. 109, No. 5, 1842-5 (March 1, 1958).

The permutation symmetries of the even and the odd beta couplings are investigated for 2^n-rowed spinors. In the usual four-rowed case there are two quadratic forms which are independent of the order of writing the spinors. In the usual even case these are $\Sigma\, C_\sigma{}^4 |g_\sigma|^2$ and $|g_S + 4g_A - g_P|^2$; in the odd case. $\Sigma\, C_\sigma{}^4 |u_\sigma|^2$ and $\frac{1}{2}|u_S + u_P|^2 + 6|u_T|^2$. For eight-rowed spinors with even couplings there are two completely antisymmetric forms; with odd couplings there is again only one. A.

530.145

2142. USE OF THE CHEW–LOW EQUATION IN STRONG COUPLING. C.J.Goebel.
Phys. Rev., Vol. 109, No. 5, 1846-8 (March 1, 1958).

In charged scalar fixed-point-source theory, the isobar energies and scattering amplitudes in the strong-coupling limit are derived by extending the Serber–Lee solution with the aid of perturbation arguments. A.

530.145

2143. ADMISSIBLE SOLUTIONS OF THE COVARIANT TWO-BODY PROBLEM. F.L.Scarf and H.Umezawa.
Phys. Rev., Vol. 109, No. 5, 1848-53 (March 1, 1958).

The spectrum of Wick's two-body problem is examined with respect to normalization conditions and the assumptions made in deriving the equation. The problem is considerably simplified by using a formalism based on Sakata–Taketani field operators. It is found that the spurious state amplitudes (suitably normalized) have a behaviour inconsistent with the assumptions used by Gell-Mann and Low to derive the bound-state equation. Similar results are found for the two-fermion problem if the vertex operator is $(1 + \gamma_5)$, and it is suggested that all spectra of the Bethe–Salpeter equation contain only three quantum numbers. A.

530.145

2144. ENERGY SHIFTS IN THE FEYNMAN FORMALISM. L.S.Rodberg.
Phys. Rev., Vol. 110, No. 1, 277-8 (April 1, 1958).

The relation between the S matrix and the energy-level shift is demonstrated in a form which permits the use of the Feynmann methods of calculation. It is also shown that vacuum fluctuations and "unlinked clusters" do not contribute to the energy of a physical system. A.

530.145

2145. TIME REVERSAL, CHARGE CONJUGATION, MAGNETIC POLE CONJUGATION, AND PARITY. N.F.Ramsey.
Phys. Rev., Vol. 109, No. 1, 225-6 (Jan. 1, 1958).

If magnetic poles exist, some arguments from symmetry may need revision. The TCP theorem is replaced by a TMCP theorem; the assumption of CP invariance no longer implies that particles cannot have electric dipole moments. R.J.N.Phillips

530.145 : 535.33

2146. ON THE RELATIVISTIC DOUBLETS OF SPECTRAL LINES. R.H.Penfield and H.Zatzkis.
J. Franklin Inst., Vol. 265, No. 2, 117-24 (Feb., 1958).

The splitting of the energy levels predicted by the Dirac equation for a particle moving in a central field is determined. The relativistic effects consist of (1) a common displacement of the energy levels, and (2) a split into doublets for all states whose angular momentum is not zero. This first effect is, of course, difficult to assess experimentally while the second is more readily verified by experiment. The calculations are based on a method which treats the relativistic effects as a perturbation and final expressions are given for the level splitting in the special case of the harmonic oscillator and the rigid rotator. A.

530.145

2147. THE RELATIVISTIC LIMIT OF THE THEORY OF SPIN $\frac{1}{2}$ PARTICLES. M.Cini and B.Touschek.
Nuovo Cimento, Vol. 7, No. 3, 422-3 (Feb. 1, 1958).

A transformation, very similar to that of Foldy and Wouthuysen is found which leads to a form of the Hamiltonian in which positive and negative spirality states are separately described by two-component spinors. In the new representation the Dirac equation obtains in general the same form as that for the massless neutrino. The actual separation into two components is then effected by the projection operators $(1 \pm \Gamma_5)$, where Γ_5 is the γ_5-matrix in the new representation. P.Roman

530.145

2148. ON THE RARITA–SCHWINGER METHOD IN THE THEORY OF HALF-INTEGRAL SPIN PARTICLES. É.E.Fradkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1479-82 (1957). In Russian.

The possibility of generalization of the Rarita–Schwinger method of setting up the Lagrangian for particles with large spins ($s > \frac{3}{2}$) is examined. It is shown that the result obtained by Moldauer and Case is valid only for particles of spin $\frac{3}{2}$. A.

530.145 : 539.12

ANOMALOUS EQUATIONS FOR SPIN 1/2 PARTICLES. See Abstr. 1809

530.145 : 539.12

THEORY OF THE NEUTRINO WITH ORIENTED SPIN. See Abstr. 1823

530.145

2149. ON THE NON-LINEAR GENERALIZATION OF THE MESON AND SPINOR FIELD EQUATIONS. D.F.Kurdgelaidze.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1156-62 (1957). In Russian.

An exact periodic solution of the non-linear generalized Klein–Gordon and Dirac equations is considered. The energy of the non-linear classical meson field is compared with that derived from quantum theory. A.

530.145

2150. OUTGOING BOUNDARY CONDITION IN REARRANGEMENT COLLISIONS. E.Gerjuoy.
Phys. Rev., Vol. 109, No. 5, 1806-14 (March 1, 1958).

The boundary condition on the solution to the nonrelativistic time-independent Schrödinger equation for arbitrarily complicated rearrangements of spinless particles is carefully examined. For real energies E it is shown that the outgoing boundary condition on the scattered wave φ need not imply that φ is "everywhere outgoing". This and similar considerations make apparent the fact remarked by Foldy and Tobocman, namely that the Lippmann–Schwinger integral equation need not have a unique solution for real energies. The relationship of this result to the added fact that solutions to the Lippmann–Schwinger integral equation are unique for complex energies $E + i\epsilon$, $\epsilon > 0$ is discussed, as is also the relationship of the usual operator manipulations to the outgoing boundary condition. A.

530.145

2151. FORM OF SCATTERING AMPLITUDE FOR TWO SYSTEMS OF ARBITRARY SPINS. R.H.Capps.
Phys. Rev., Vol. 109, No. 5, 1823-9 (March 1, 1958).

A general expression for the elastic scattering amplitude of two systems of arbitrary spins is derived in terms of the particle spin operators and momenta. Invariance under space and time translation and space rotation is assumed. Time-reversal and space-rotation invariances are shown to require certain terms of the derived expression to be zero. Two cases are considered; the scattering of two systems of finite mass, and the scattering of a massless particle from a system of finite mass. A.

530.145

2152. VARIATIONAL PRINCIPLES FOR THE WAVE FUNCTION IN SCATTERING THEORY. S.Altshuler.
Phys. Rev., Vol. 109, No. 5, 1830-6 (March 1, 1958).

Variational principles are designed for the solution of the Schrödinger equation when a point source is placed in the presence of an inhomogeneous, absorbing medium represented by an arbitrary complex potential function. When the point source is allowed to recede to infinity, these stationary structures reduce to variational principles for the wave-function in the standard scattering problem, namely the outgoing solution to the Schrödinger equation for an incident plane wave. Finally in the asymptotic region, the well-known bifunctional variational principles for the transition amplitudes arise automatically from the stationary forms for the wave-function describing the standard scattering problem. A few examples leading to variationally improved wave-functions are discussed. A.

530.145 : 539.12

2153. RELATION BETWEEN SCATTERING AND MULTIPLE PARTICLE PRODUCTION. S.Z.Belen'kiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1171-5 (1957). In Russian.

According to Fermi's theory multiple production of particles in high-energy collisions should be determined by the statistical weight of the respective state. In the present investigation the statistical weight is calculated taking into account mutual interaction of pairs of particles and it is shown that in this case the scattering phase of the interacting particles is involved as a characteristic of the interaction. In resonance scattering the effect of scattering reduces to the appearance of an intermediate "isobaric" state which should be included in the statistical theory. A.

530.145

2154. QUANTUM STATES OF PARTICLES INTERACTING WITH A HARMONICALLY OSCILLATING CONTINUUM, THE COUPLING FORCE BEING ARBITRARY. I. THE CASE WITHOUT TRANSLATIONAL SYMMETRY. V.M.Bulmistrov and S.I.Pekar.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1193-9 (1957). In Russian.

A straightforward variational method was used to calculate the energy of the ground state of the system described. The results are applied to F-centre and F'-centre problems as particular cases. In the particular cases of weak and strong coupling between the

particle and vibrations the computed energy coincides respectively with the exact result of perturbation theory (second approximation) and with the results of the adiabatic approximation. The obtained formulae may be considered as interpolation formulae in the intermediate coupling region in which the effective radius of the state of a localized electron is large and the criteria for the continual F- and F'-centre models are satisfactorily fulfilled. A.

530.145

2155. APPLICATION OF THE DIRAC–FOCK–PODOLSKY METHOD TO A MECHANICAL MANY-BODY PROBLEM. I.G.Fikhtengol'ts.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1404-11 (1957). In Russian.

The general form of the classical constants of motion and a generalized expression for the inertial mass of a body were deduced in the relativistic many-body problem by applying the many-time formalism. The results are applied to a system of interacting electrical charges and to a system of bodies interacting gravitationally. A.

530.145

2156. MECHANICAL INTERPRETATION OF THE GAUGE INVARIANCE OF FIRST KIND ACCORDING TO THE HYDRODYNAMICAL REPRESENTATION OF THE QUANTUM MECHANICAL EQUATIONS. G.Lochak.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2023-5 (Dec. 4, 1957). In French.

The result of a previous note for the Dirac field (Abstr. 1076/1957) is extended to any "spin fluid, and, thereby to all the equations of wave mechanics". J.Lascoux

530.145 : 539.12

DISPERSION RELATIONS FOR NUCLEON–NUCLEON SCATTERING. See Abstr. 1844

530.145

2157. NOTE ON THE FORCED AND DAMPED OSCILLATOR IN QUANTUM MECHANICS. E.H.Kerner.
Canad. J. Phys., Vol. 36, No. 3, 371-7 (March, 1958).

The wave equations for the forced, damped, and forced and damped oscillators are solved in closed form for an arbitrary forcing function; the solutions produced being in one-to-one correspondence with the stationary states of the unforced, undamped Hamiltonian H_0. The quantal motion is closely connected with the classical: for the forced oscillator the probability density is that of H_0 but moves as a whole with the classical motion, for the forced and damped oscillator this motion is accompanied by a contraction progressing eventually into a delta function at the classical position. Transition probabilities between states of H_0 are computed in the case of forced motion and depend solely on the classically acquired energy of the oscillator at any time. The transition probability vanishes strictly only when this energy has a value falling at the roots of a Laguerre polynomial associated with the transition. The classical dipole radiation emitted by a disturbed oscillator is, when the damping force is identified with the force of radiation damping, that of the classical oscillator: a shifted and broadened line.

A.

530.145

2158. A THEOREM ON INVARIANT ANALYTIC FUNCTIONS WITH APPLICATIONS TO RELATIVISTIC QUANTUM FIELD THEORY. D.Hall and A.S.Wightman.
K. Danske Vidensk. Selsk. mat.-fys. Medd., Vol. 31, Paper 5, 41 pp. (1957).

The paper is in three parts of which the first two are mathematical. In the first part, a detailed proof is given of a previously announced theorem: an analytic function of n four-vector variables invariant under the orthochronous Lorentz group is an analytic function of their scalar products. The second part is devoted to a preliminary study of the domain of analyticity of such invariant analytic functions. The third part applies the preceding results to quantum field theory. It is shown that the vacuum expectation value $(\Psi_0, \varphi(x_1)\ldots\varphi(x_n)\Psi_0) = F^{(n)}(x_1, \ldots x_n)$, where $\varphi(x)$ is neutral scalar field, is an analytic function of the real variables $x_j - x_{j+1}$, $j = 1, \ldots n-1$ in a region where all these vectors are space-like. It is shown that the values of $F^{(n)}$ for all values of its arguments are uniquely determined in terms of its values for space-like separations, and that, for $n = 2,3,4$, $F^{(n)}$ is determined from its values at points where all times are equal. These results are applied to prove generalizations of two theorems of R.Haag. In effect, these theorems show that, to give different physical predictions, two theories of an interacting field which satisfies the canonical commutation relations must use inequivalent representations of the commutation relations. A.

530.145 : 530.162

2159. DISTRIBUTION FUNCTIONS FOR NONCOMMUTING OPERATORS. A.O.Barut.
Phys. Rev., Vol. 108, No. 3, 565-9 (Nov. 1, 1957).

The properties are investigated of a certain class of functions $f(\alpha, \beta', \gamma', \ldots)$ of non-commuting observables $\alpha, \beta, \gamma, \ldots$. They have all the usual properties of distribution functions, except that they are complex. They satisfy simple Markoff-type stochastic equations, and permit the calculation of the expectation values unambiguously. Conversely, quantum theory can be formulated in terms of such distribution functions having the prescribed properties. A.

530.145 : 539.14

2160. BRUECKNER'S THEORY AND THE METHOD OF SUPERPOSITION OF CONFIGURATIONS. R.K.Nesbet.
Phys. Rev., Vol. 109, No. 5, 1632-9 (March 1, 1958).

The method of superposition of configurations, which provides a general solution of the quantum-mechanical many-particle problem (for fermions), is reformulated so that equations may be compared with those used in the Brueckner theory. Important differences occur in application to finite or nonuniform systems for which the Hartree–Fock or Brueckner self-consistent orbitals are not plane waves. In such cases nonvanishing single-particle matrix elements occur which cannot be described by the Brueckner formalism based on a two-particle operator. Equations for an effective two-particle operator, equivalent to the variational equations of the method of superposition of configurations, are derived for a basis of Hartree–Fock orbitals. At the expense of making the orbital basis dependent upon the effective two-particle operator, the orbital basis can be determined by a condition which is essentially that of the Brueckner method. This condition removes a class of matrix elements which do not necessarily vanish in the Hartree–Fock basis although they would be neglected to second order in a perturbation calculation starting from the Hartree–Fock wave-function. The equations for the effective two-particle operator are formally the same in both cases but lead to different operators because of the different choice of basis. In neither case can the equations be written in terms of products of such operators, a formalism assumed in the Brueckner theory. It is shown that the Brueckner condition is not equivalent to the condition which would determine the best possible orbital basis for the form of wave-function implied by the use of an effective operator dependent on two particles only. The argument of the present paper is limited to systems with a finite number of particles, since the variational principle used here is not applicable without modification to systems with an infinite number of particles. A.

530.145

2161. PERTURBATION THEORY IN WAVE MECHANICS. W.H.Young and N.H.March.
Phys. Rev., Vol. 109, No. 5, 1854-5 (March 1, 1958).

This note is intended to supplement a paper by Speisman (Abstr. 9546/1957) by focusing attention on some points of a rather practical nature. In particular, it is shown that the method of Dalgarno and Lewis arises naturally as a special case of the present scheme, and that an upper bound to the energy can be obtained almost immediately once the results of the Rayleigh–Schrödinger theory are known to third order. A.

530.145 : 530.12

2162. DYNAMICAL THEORY IN CURVED SPACES. I. A REVIEW OF THE CLASSICAL AND QUANTUM ACTION PRINCIPLES. B.S.DeWitt
Rev. mod. Phys., Vol. 29, No. 3, 377-97 (July, 1957).

First of a series of papers designed to extend quantum theory to the broader content of general relativity. A study of Feynman quantization in curved spaces is incorporated and leads to a curious ambiguity in the definition of the quantum Hamiltonian involving the invariant curvature. W.A.Hepner

530.145 : 530.12

2163. THE "RELATIVE STATE" FORMULATION OF QUANTUM MECHANICS. H.Everett,III.
Rev. mod. Phys., Vol. 29, No. 3, 454-62 (July, 1957).

Quantum theory is recast in a form believed suitable for eventual application to general relativity (closed universe). In place of the "external observation" necessary for the interpretation of pure wave mechanics, it is postulated that every system that is subject to external observation can be regarded as part of a larger isolated system. The representations of the state of the composite system in terms of products of states of constituent subsystems lead to the concept of the relativity of states, in the sense that to any one state for one subsystem there will correspond a unique "relative state" for the remainder of the composite system. All

observation processes are regarded simply as interactions between subsystems which produce such correlations. The new formulation leads to the conventional probability interpretation of wave mechanics. W.A.Hepner

530.145 : 539.19

USE OF THE BORN–OPPENHEIMER APPROXIMATION IN MOLECULAR PROBLEMS. See Abstr. 2012

530.145 : 530.12

2164. ASSESSMENT OF EVERETT'S "RELATIVE STATE" FORMULATION OF QUANTUM THEORY. J.A.Wheeler.
Rev. mod. Phys., Vol. 29, No. 3, 463-5 (July, 1957).

It is pointed out that, while the conclusions correspond completely, in familiar cases, to those of the conventional "external observation" form of quantum mechanics, the conceptual scheme is quite different. W.A.Hepner

530.145

2165. ON THE STATISTICAL INTERPRETATION OF QUANTUM THEORY. R.L.Stratonovich.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1483-95 (1957). In Russian.

Operator ordering principles are considered as a basis of a statistical interpretation. An especially concise expression for the trajectory distribution in functional space in terms of the action functional is obtained in the case of the lowest energy state. Bi-chronological ordering development in time is a Markov process for which a continual distribution density is found. A.

530.145 : 530.162

2166. ON AN APPLICATION OF ZUBAREV'S METHOD OF SUPPLEMENTARY VARIABLES TO STATISTICAL PHYSICS. A.Pavlikovskiĭ and V.Shchuruvna.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 1, 61-4 (1958). In Russian.

The method of supplementary variables developed by D.N.Zubarev (Abstr. 754/1955) is used to calculate the statistical sum

$$Z_N = \sum_{\psi} \langle \psi \mid e^{-\beta H} \mid \psi \rangle,$$

where $\beta = 1/kT$, H is the Hamiltonian, ψ the state vector, for a system of N Fermi particles interacting with each other under a central two-body potential. The Hamiltonian then splits into a sum of Hamiltonians due to free fermions, free oscillators (whose frequency depends on the interaction potential) and interaction terms. Neglecting these interaction terms the Z_N can be calculated. An explicit upper bound for Z_N is found in the limit of large N, after the simplification of neglecting certain antisymmetric states. M.J.Kearsley

530.162

2167. BROWNIAN MOVEMENT. D.K.C.MacDonald.
Phys. Rev., Vol. 108, No. 3, 541-5 (Nov. 1, 1957).

A general analysis of the Brownian movement is given, which is not limited to systems having a linear relaxation mechanism. Detailed results are obtained for the case of modest non-linearity, to which presumably all problems of physical interest are limited. A.

530.162 : 533.75

2168. MODIFIED VIRIAL THEOREM FOR TOTAL MOMENTUM FLUCTUATIONS. J.L.Lebowitz.
Phys. Rev., Vol. 109, No. 5, 1464-5 (March 1, 1958).

A modified form of the virial theorem, which relates the fluctuations in the total linear momentum of a "virial" of the external forces acting on a physical system, is proven both classically and quantum-mechanically. A.

GENERAL MECHANICS. MECHANICS OF SOLIDS

531.577

2169. A NOTE ON PENETRATION BY ROTATING SHAPED CHARGES. S.Singh.
Proc. Phys. Soc., Vol. 71, Pt 3, 508-12 (March, 1958).

Deals with the penetration of a target by a high-explosive charge detonated in a container having a metal-lined cavity, usually known as a shaped charge. When the charge is rotating at the instant of detonation, increase of the cross-section of the jet has been observed but the velocity of the jet was unaffected. The present paper deals theoretically with the depth of penetration and correlates it with the angular velocity of the liner in a rotating shaped charge. Curves are given showing the depth of penetration into a mild steel target of a charge detonated at a stand-off distance of 7.62 cm. The depth of penetration decreases from about $15\frac{1}{2}$ cm with a stationary charge to about 9 cm at a rotary speed of 100 rev/sec and to about 6 cm at 400 rev/sec. Calculated profiles of the holes made in the steel show that the cross-section at the bottom of the hole increases as the penetration becomes shallower as a result of increase of rotary speed. The radius near the bottom of the hole increases with increase of the speed of the shaped charge. Reasonable agreement occurred between theoretical and experimental profiles. A.C.Whiffin

MECHANICAL MEASUREMENTS

531.717

2170. THE MEASUREMENT OF THICKNESS. G.Keinath.
Circ. Nat. Bur. Stand., No. 585, 79 pp. (1958).

Methods for measurement of thickness are treated in seven groups (mechanical, chemical, electrical, magnetic, optical, X-ray and radioactive) according to physical operating principles. Ranges, accuracies, advantages and limitations are discussed. A bibliography of references, a list of suppliers and an index of gauges, methods, applications and trade names covered are appended. A.

531.787

2171. WIDE-RANGE THERMAL CONVECTION MANOMETER. J.A.McMillan and T.Buch.
Rev. sci. Instrum., Vol. 28, No. 11, 881-2 (Nov., 1957).

A pressure gauge covering both the Pirani and liquid manometer ranges, easily adaptable for continuous recording, was devised and successfully operated. In the pressure range of the Pirani gauge, the working principle is that of the thermal conductivity at low pressures; at high pressures, on the contrary, a convection stream takes place, which depends on pressure and determines temperature variations in the filament. Experimental results give maximum sensitivity in the range 0.5-5 torr and a reasonable sensitivity for pressures up to one atmosphere. A.

MECHANICS OF FLUIDS

532.14

2172. PORTABLE LIQUID DENSITY INSTRUMENT EMPLOYING TRANSISTORS. C.W.Hargens.
Rev. sci. Instrum., Vol. 28, No. 11, 921-3 (Nov., 1957).

A convenient electromechanical instrument was developed to take the place of sets of sensitive hydrometers in measuring liquid densities. The range covered by the particular design is 0.8000 to 1.0000 and could be extended without impairing its accuracy. Temperature-controlled liquid samples of 100 cm^3 are used. The instrument derives its sensitivity from a miniature differential transformer and associated transistor electronics. One of the primary advantages of the device is positiveness of reading. A.

532.5 : 530.162

2173. STATISTICAL MECHANICS OF TRANSPORT PROCESSES. XI. EQUATIONS OF TRANSPORT IN MULTICOMPONENT SYSTEMS. R.J.Bearman and J.G.Kirkwood.
J. chem. Phys., Vol. 28, No. 1, 136-45 (Jan., 1958).

The equations of hydrodynamics including the equations of continuity, equations of motion of the individual components as well as the over-all equation of motion, and the energy transport equation are derived from statistical mechanics. Introduction of perturbations to the singlet and pair space distribution functions linearized in the temperature gradient, diffusion velocities, and the local rate of shear leads in the stationary case to the linear relations of irreversible thermodynamics between the gradients of temperature and chemical potential and the fluxes of heat and matter. A.

532.517.4 : 551.515.11

2174. SPECTRUM OF TURBULENT MIXING. R.Bolgiano, Jr.
Phys. Rev., Vol. 108, No. 5, 1348 (Dec. 1, 1957).

It is pointed out that the result of Wheelon (Abstr. 4005/1957) for the spectrum of mean square fluctuations produced by turbulent

mixing of an established gradient is incorrect in the inertial subrange. When allowance is made for molecular diffusion, the spectrum S(k) is not proportional to k^{-3}, but more nearly to $k^{-5/3}$, which is in agreement with experimental studies of the spectrum of refractive index fluctuations. The data on the scattering of radio waves, quoted by Wheelon in support of his theory, cannot, therefore, be explained in terms of turbulent mixing of mean gradients.

G.M.Brown

532.612.4

2175. SURFACE TENSION OF TITANIUM, ZIRCONIUM, AND HAFNIUM. A.W.Peterson, H.Kedesdy, P.H.Keck and E.Schwarz.
J. appl. Phys., Vol. 29, No. 2, 213-16 (Feb., 1958).

The surface tensions of liquid Ti, Zr, and Hf at their melting points were measured in pure argon atmosphere by the drop-weight method. A uniform longitudinal field induction coil was used to melt the sample rod tip. The average values obtained were 1390 ± 40, 1400 ± 40, and 1460 ± 40 dynes/cm, respectively. A.

MOLECULAR THEORY OF LIQUIDS

532.7 : 536.7

2176. STATISTICAL THERMODYNAMICS OF QUANTUM FLUIDS. R.M.Mazo and J.G.Kirkwood.
J. chem. Phys., Vol. 28, No. 4, 644-7 (April, 1958).

An approximate technique for determining the thermodynamic properties of quantum fluids by the method of molecular distribution functions is developed. It consists of a separation of the problem into two parts, the determination of the classical pair distribution function at an effective temperature τ, and the quantum-mechanical calculation of τ. It is further shown that all thermodynamic quantities of interest can be easily computed if τ is known. A.

532.73

2177. THEORY OF POTENTIALS OF AVERAGE FORCE AND RADIAL DISTRIBUTION FUNCTIONS IN IONIC SOLUTIONS. E.Meeron.
J. chem. Phys., Vol. 28, No. 4, 630-43 (April, 1958).

The procedure employed by Mayer for the calculation of osmotic pressure and activity coefficients of ions in solution from the Fuchs expansion of the grand potential in multicomponent systems is applied to the recently obtained expansion of the potential of average force in these systems. The resulting multiply infinite series are summed to give a series analogous to the original expansion, involving the Debye–Hückel potential of average force in a remarkably simple way. A similar expansion for the radial distribution function is presented. Explicit expression for both quantites, exact through terms of first order in the ionic concentration, are given. An expansion for the osmotic pressure, analogous to the virial expansion, is presented. The presence of the Debye–Hückel potential of average force in all these expansions is discussed, and the possibility of obtaining the potential of average force exact through terms of second order in the ionic charging parameters is indicated. Possible applications to ionic conductivity, diffusion, and viscosity are discussed. Additional applications to the theory of defects in ionic crystals, impurity conduction in semiconductors, etc. are suggested. The significance of the individual terms in the new expansions is discussed. Proof of a n-fold convolution theorem for Fourier transforms is presented.

A.

532.77

2178. RANDOM FLIGHT MODEL IN THE THEORY OF THE SECOND VIRIAL COEFFICIENT OF POLYMER SOLUTIONS. A.C.Albrecht.
J. chem. Phys., Vol. 27, No. 5, 1002-13 (Nov., 1957).

The theory of the second virial coefficient, $A_2(M_2,T)$, for dilute polymer solutions is investigated from the point of view, first developed by Zimm, of the Ursell–Mayer-like development in terms which successively represent increasing numbers of contacts between molecular subunits of flexible chain molecules. The methods used by Fixman in treating excluded volume problems in the random flight model are employed. Evaluation is carried out to the triple contact approximation. A formal analysis of all higher terms is presented and the contribution of one class of terms is evaluated exactly. The remaining terms appear to be inaccessible to numerical evaluation by ordinary methods so that a rigorous discussion of the asymptotic behaviour of A_2 is precluded. Semiquantitative arguments, however, indicate favourable agreement with experiment, provided intramolecular excluded volume effects are considered. A.

MECHANICS OF GASES

533.15

2179. THERMAL DIFFUSION FACTORS FOR THE NOBLE GASES. T.I.Moran and W.W.Watson.
Phys. Rev., Vol. 109, No. 4, 1184-90 (Feb. 15, 1958).

With an all-metal "Trennschaukel" of the type developed by Clusius and Huber, consisting of 22 tubes interconnected by single capillaries, and with the gas oscillating with a period of 15 sec, the thermal diffusion factor α for all of the noble gases as a function of temperature has been measured in the range 230°K-600°K. The reduced thermal diffusion factors α_0 for krypton and xenon are positive even at the lowest temperature and increase so markedly with temperature as to indicate the advisability of operating isotope-separating columns with these gases with the cold wall at a somewhat elevated temperature. For neon the α v. T curve has but a slight positive slope, while for helium α actually decreases as T increases in this range. The values of R_T (= ratio of observed α to its theoretical first-approximation value based on rigid elastic sphere molecules) agree quite well with those estimated from viscosity data except for helium. The intermolecular potential is best represented by a modified Buckingham (exp-six) potential with appropriately chosen parameters. A.

533.16

2180. INTRINSIC BULK VISCOSITY IN MONATOMIC AND DIATOMIC GASES. R.E.Nettleton.
J. appl. Phys., Vol. 29, No. 2, 204-12 (Feb., 1958).

The Born–Green theory, employing the Kirkwood superposition approximation, is investigated as a means of calculating the intrinsic bulk viscosity — a bulk viscosity due solely to Van der Waals interactions — in a monatomic gas. In the framework of the Born–Green theory, it is found that the Kirkwood approximation does not introduce irreversibility and leads to homogeneous integral equations with no normalizing conditions. By the neglect of terms of the order of contributions from triple collisions, expressions for the bulk viscosity are derived in terms of other thermodynamic quantities which yield rough values of the order of one micropoise for argon and nitrogen at 0°C, 1 atm. A.

533.51

2181. RATE OF EXHAUST THROUGH A TUBE OR ORIFICE. J.Rothstein.
Rev. sci. Instrum., Vol. 29, No. 3, 243-4 (March, 1958).

A formula for the rate of exhaust through a tube or orifice given in Dushman, Scientific Foundations of Vacuum Technique (New York: Wiley and Sons, 1949, p. 121-5), is inconvenient to apply except in two limiting cases. The differential equation from which this formula is derived is solved in another way, giving a simple hyperbolic cotangent formula easy to discuss or apply over the entire range. It is shown that the formula permits of "ballistic" use of a tube or orifice to measure pressure surges too rapid or too large to be monitored in the usual way. Several applications are suggested to electron tube manufacture and vacuum processing of various materials. A.

533.58

2182. BARIUM ABSORPTION PUMPS FOR HIGH-VACUUM SYSTEMS. R.W.Cloud, L.Beckman and J.G.Trump.
Rev. sci. Instrum., Vol. 28, No. 11, 889-92 (Nov., 1957).

A simple high-vacuum pump which combines large areas of evaporated barium with a source of ionization is described. Though of moderate pumping speed this barium-ionization pump is capable of maintaining high vacuum in unoutgassed sealed-off systems even in the presence of organic sealing materials. Simplicity is achieved by use of externally applied heat for barium evaporation which may be performed initially or periodically as required. Data are presented which show the capabilities and limitations of such absorption systems. The similarity of this absorption process to that producing oxidation of metals in air is noted. A.

533.6.011

2183. THE APPLICATION OF THE CENTRIPETAL EFFECT IN AIR TO THE DESIGN OF A PUMP. B.Popper and M.Reiner.
Brit. J. appl. Phys., Vol. 8, No. 12, 493-4 (Dec., 1957).

Gives the details of the rotor of the pump used in the original investigation, as the drawing included in the original letter (Abstr. 5116/1957) contained intended improvements of the instrument, which however did not produce desired results when incorporated after publication of the letter. For the theory of the effect see Abstr. 8458 (1957). J.M.Zarzycki

533.6.011

2184. THE FLOW OF GAS AT VERY LOW PRESSURE.
C.W.Oatley; W.Steckelmacher.
Brit. J. appl. Phys., Vol. 8, No. 12, 494-5, 495-6 (Dec., 1957).

Steckelmacher, referring to Oatley's improved method of calculating gas flow through composite systems (Abstr. 6943/1957), defends the use of the conventional method. He shows how by means of slightly modified conventional approach, Oatley's formulae could be derived.

Oatley replies that his equation for the speed of the diffusion pump cannot be derived by Steckelmacher's method. His main objection to the "aperture method" lies in the theoretical proof of its validity. J.M.Zarzycki

MOLECULAR THEORY OF GASES

533.7 : 530.162

2185. ON TIME SMOOTHING. A MODEL FOR MOMENTUM TRANSPORT. M.Fixman.
J. chem. Phys., Vol. 28, No. 3, 397-400 (March, 1958).

An investigation is made of the time smoothing properties of the transport equations previously derived by the author (Abstr. 7626/1957). A model is introduced, wherein momentum is transferred from one portion of a fluid medium to another via acoustical waves. This model is applied to the problem of viscous flow of a rare gas, and it is found that it is permissible and desirable to allow the time smoothing interval τ to become infinitely large. In practice this means that $\tau \gg \beta^{-1}$, where β is a friction constant. The model incidently yields a value for the viscosity coefficient in fair agreement with the Chapman–Enskog hard sphere value. A.

533.7

2186. HIGHER APPROXIMATIONS FOR THE TRANSPORT PROPERTIES OF BINARY GAS MIXTURES. III. ISOTOPIC THERMAL DIFFUSION. S.C.Saxena and E.A.Mason.
J. chem. Phys., Vol. 28, No. 4, 623-5 (April, 1958).

For Pt II see Abstr. 7667 (1957). Tables of the reduced isotopic thermal diffusion factor as a function of a reduced temperature are given for the exp-six potential with potential parameter α = 12, 13, 14, 15, and for the Lennard-Jones (n–6) potential with potential parameter n = 12, ∞. These tables are based on recently derived higher approximations and are intended to supersede previous tabulations, which are of lower accuracy. A.

533.7

2187. TRANSPORT EQUATION IN QUANTUM GASES.
H.Mori and J.Ross.
Phys. Rev., Vol. 109, No. 6, 1877-82 (March 15, 1958).

A derivation of the quantum-mechanical analogue of the Maxwell–Boltzmann equation of transport for gases at low density is presented. The analysis requires: the definition of a time differential which is necessary for the selection of only secular variations in the time dependence of the distribution functions (coarse-graining in time); a binary collision approximation; the connection between the phase-space transformation function, relating the Wigner distribution function at different times, and the transition matrix in the theory of scattering of two particles; and a coarse graining in configuration space leading to a kinetic equation for spatially nonuniform systems. A consequence of the binary collision approximation is the exclusion of the effects of symmetrization (Bose–Einstein or Fermi–Dirac statistics) resulting in density-dependent terms. A.

VIBRATIONS. ACOUSTICS

534.2

2188. DISPERSION OF ELASTIC WAVES IN SODIUM CHLORIDE. A.Granato, J.deKlerk and R.Truell.
Phys. Rev., Vol. 108, No. 3, 895-6 (Nov. 1, 1957).

Velocity dispersion was measured for compressional elastic waves propagated in the [100] direction in NaCl before and after 0.06% deformation in compression. Deformation increases the magnitude of the dispersion from 0.5% to 4% and moves it to lower frequencies. J.Adam

534.21

2189. NONAXIALLY SYMMETRIC MOTIONS OF CYLINDRICAL SHELLS. I.Mirsky and G.Herrmann.
J. Acoust. Soc. Amer., Vol. 29, No. 10, 1116-23 (Oct., 1957).

A Timoshenko-type theory of cylindrical shells, developed by the authors in a previous paper (J. Appl. Mech., Vol. 23, 563-8, 1956) for the case of axial symmetry, is generalized to include non-axially-symmetric motions. As an application, the propagation of free harmonic waves in the axial direction of a shell of infinite extent is studied and discussed in the light of previous work on this problem. A.

534.21 : 532.51

2190. ACOUSTIC STREAMING NEAR A BOUNDARY.
W.L.Nyborg.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 329-39 (April, 1958).

An approximate solution is developed for sonically-induced steady flow near a fluid–solid interface. The result is valid, subject to stated conditions, for the flow near any portion of surface in the vicinity of which the irrotational oscillatory velocity distribution u_a is known. The principal conditions on the validity is that the acoustic boundary layer parameter $(\nu/\omega)^{1/2}$ (where ω is the angular frequency and ν is the kinematic viscosity coefficient for the fluid) should be small compared to the scale of u_a. Applications of the general result are made to special situations, one case of particular interest being that of a small source near a rigid plane. The conclusion is reached that small compressible bodies, and especially resonant gas bubbles, resting on boundaries, are likely sites of pronounced microstreaming in a sound field. A.

534.21 : 538.566.2

2191. PROPAGATION OF WAVES THROUGH A SHEET OF THE MEDIUM WITH A CUBIC PERIODIC STRUCTURE. P.Gosar.
Nuovo Cimento, Vol. 7, No. 6, 742-63 (March 16, 1958).

This investigation is concerned with the scattering of plane scalar waves by a plane-parallel sheet of the medium, whose refractive index n(r) is a periodic function of position vector r with a cube as the elementary period. A method to obtain an approximate solution of the wave equation is developed for the case of normal and oblique incidence of the ingoing wave in the sheet. Only the propagation of waves through the media for which the wave equation, written in rectangular co-ordinates, is separable, is investigated in full detail. Two interesting examples are given. The theory is applicable to the cases where only a small part of the incident energy is scattered in the waves of higher modes. A.

534.222.2

2192. ON THE THEORY OF NON-STATIONARY DISCONTINUITIES IN RELAXING MEDIA.
E.V.Stupochenko and I.P.Stakhanov.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 1, 65-7 (1957). In Russian.

The decay of shock waves in relaxing media is studied in detail. The solution to the hydrodynamical equations supplemented by equations of the relaxation processes is given for the case of small perturbations. Initial conditions are imposed on the disturbance u(x,t) (corresponding, for example, to the instantaneous change of velocity of a piston in a cylindrical pipe containing a yielding medium) and the solution for u(x,t) is expressed first in the form of an integral. The paths of integration are discussed in detail. The final solution shows how the disturbance decays exponentially with distance. M.J.Kearsley

534.222.2 : 533.21

2193. SHOCK HUGONIOT OF AIR. W.E.Deal.
J. appl. Phys., Vol. 28, No. 7, 782-4 (July, 1957).

Experiments are described in which an explosive-driven plate sets up a strong shock in air in contact with the plate. Plate velocity and air shock velocity are measured by means of a high-speed framing camera. A pressure–compression relation results from these measurements through use of the conservation equations of hydrodynamics. The experimental results up to pressures of 200 bars are compared to a calculated relation. A.

534.222.2

2194. DETERMINATION OF THE SPEED OF SOUND IN SULFURHEXAFLUORIDE IN A SHOCK TUBE.
I.I.Glass and J.G.Hall.
J. chem. Phys., Vol. 27, No. 5, 1223 (Nov., 1957).

This was found to be 454.5 ± 0.5 ft/sec for a weak shock at 30.0°C and 750 mm Hg at the head of a rarefaction wave in commercial SF_6. Observed details of the wave profiles are given, which, with the result above, indicate that the transitional, rotational, and vibrational states are excited. P.Gray

534.222.2 : 537.562

2195. SHOCK WAVES OF LARGE AMPLITUDE IN AIR. Ya.B.Zel'dovich.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1126-35 (1957). In Russian.

The state of air compressed by a strong shock wave is examined by taking into account dissociation and ionization. Approximate expressions for the density and temperature in this region are given. The radiation from the front of the shock wave is considered. With increasing amplitude of the shock wave, the visible temperature of the wave exhibits a maximum, due to formation of opaque layer of air in front of the wave, preheated by radiation. The structure of the shock wave is studied with radiative heat exchange taken into account. A rigorous proof of the impossibility of a continuous solution and of the necessity of discontinuities in the velocity, density and temperature in a strong shock wave is presented. The wave structure in a strongly ionized gas is investigated taking into account slow energy transfer between ions and electrons. A.

534.222.2 : 537.562

2196. STRUCTURE OF A SHOCK WAVE IN A PLASMA. V.D.Shafranov.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1453-9 (1957). In Russian.

The structure of a shock wave in a plasma is investigated taking into account the difference in the electron and ion temperatures. The following cases are considered: (a) non-stationary shock wave for which energy exchange between the ions and electrons can be neglected; (b) stationary shock wave; (c) stationary shock wave in a strong magnetic field. A.

534.23 : 532.7

2197. EFFECT OF PRESSURE ON ULTRASONIC RELAXATION IN LIQUIDS. II. T.A.Litovitz and E.H.Carnevale.
J. Acoust. Soc. Amer., Vol. 30, No. 2, 134-6 (Feb., 1958).

For previous part see Abstr. 5136 (1957). Ultrasonic absorption and velocity in acetic acid and triethylamine were measured up to pressures of 3280 kg/cm^2. The results show that the relaxation frequency in each liquid is independent of pressure to within experimental accuracy (±5%). The pressure data confirm the assumption of Heasall and Lamb that the loss in triethylamine is a rotational isomeric effect. The result in acetic acid are in agreement with the predictions of the monomer-dimer theory. Comparison with previous results in carbon disulphide and glycerol shows that, depending upon the mechanism, increasing the pressure can cause the relaxation frequency in a liquid either to increase, decrease or remain constant. It appears that the pressure dependence of the relaxation frequency can be useful in distinguishing the type of relaxation present. A.

534.23

2198. ON THE ATTENUATION OF HIGH AMPLITUDE WAVES OF STABLE SAW-TOOTH FORM PROPAGATED IN HORNS. I.Rudnick.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 339-42 (April, 1958).

The attenuation is studied theoretically. The shock associated with each wave is assumed to be weak. An expression for the power loss for a generalized horn is obtained. Two quantities, the limiting particle velocity amplitude and the limiting power which is transmitted per unit throat area, occur in the solution. For long, gently tapering horns these are the limits to which the particle velocity and power tend as the input to the throat is increased. Uniform-bore tubes, and exponential and conical horns, are discussed as particular examples of the general case. A.

534.23 : 537.312.62

SUPERCONDUCTING ENERGY GAP FROM ULTRASONIC ATTENUATION MEASUREMENTS. See Abstr. 1709

534.23 : 532.7

2199. QUESTION OF ULTRASONIC ABSORPTION PEAKS IN ETHYL ACETATE. R.T.Beyer and K.C.Jacob.
J. Acoust. Soc. Amer., Vol. 29, No. 9, 1034 (Sept., 1957).

Available ultrasonic absorption data for ethyl acetate are considered, including some recent evidence for two distinct relaxation peaks (Dokl. Akad. Nauk SSSR, Vol. 104, 838, 1955). Experimental and theoretical considerations suggest that the reported peak below 10 Mc/s is spurious. H.D.Parbrook

534.23

2200. ULTRASONIC ABSORPTION IN ANILIN AND IN MIXTURES. M.Cevolani and S.Petralia.
Nuovo Cimento, Vol. 7, No. 6, 866-76 (March 16, 1958).

The ultrasonic absorption, at frequencies between 9 and 27 Mc/s was measured in aniline and in aniline—CCl_4 mixtures, to investigate the causes which determine the anomalous absorption over a wide temperature range. It appears, according to a theory by Nettleton (Abstr. 5920/1957), that at high temperatures, aniline behaves like a non-associated liquid, with anomalous absorption of molecular origin. At low temperature another contribution was found, which probably indicates the formation of aggregates in aniline, and mixtures show a clear absorption maximum for a given molecular aniline concentration; the lower the temperature, the clearer the maximum, its height varying with ultrasonic frequency. A.

534.23

2201. LOSS FACTOR MEASUREMENTS IN DRY SAND. A.N.Hunter, R.D.Legge and E.Matsukawa.
Proc. Phys. Soc., Vol. 71, Pt 1, 135-6 (Jan., 1958).

This was determined at 20 kc/s from the sound attenuation coefficient per cm, and within experimental accuracy is independent of varying stress (0.28 to 4.26 lb. in^{-2}). The attenuation coefficient is approximately proportional to frequency (7.6 to 27.9 kc/s). Similar results have been reported by Schmidt (0.05 to 2 kc/s, Abstr. 3504/1955). H.D.Parbrook

534.232

2202. EFFECT OF A REFLECTING PLANE ON THE POWER OUTPUT OF SOUND SOURCES. U.Ingard and G.L.Lamb, Jr.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 743-4 (June, 1957).

The presence of a reflecting plane boundary will affect the power output of a sound source located above it. This effect may be expressed as a "power amplification factor", which was calculated for a number of elementary sound sources (monopole, dipole and longitudinal quadrupole) as a function of the distance between the plane and the source. Special attention was given to the evaluation of the source-height corresponding to minimum power output, and to the ratio between the maximum and minimum power radiated. A.

534.232

2203. ACOUSTIC CHARACTERISTICS OF MODEL PULSED JETS. S.K.Oleson and U.Ingard.
J. Acoust. Soc. Amer., Vol. 29, No. 10, 1145-6 (Oct., 1957).

The following data are presented: the directional patterns of the radiation in octave bands; the octave and narrow-band spectra of the noise from a single jet; and the pressure fluctuations when several jets are running. H.D.Parbrook

534.24

2204. SURFACE REFLECTION OF SOUND AT 100 kc. M.J.Pollak.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 343-7 (April, 1958).

Short sound pulses at 100 kc/s were transmitted over a 100 ft range in a shallow estuary. Surface-reflected signals were recorded separately from direct signals. Surface reflection was most pronounced in autumn and winter when vertical sound-speed distribution produces upward refraction in the upper ten feet of water. In spring and summer the opposite conditions prevail. Eight one-minute records, consisting of about 1200 pulses each, were analysed. When pulse amplitudes and their frequencies of occurrence were transformed into dimensionless units, it became feasible to combine all records into one frequency distribution diagram. Despite considerable scatter in the data, there is a marked resemblance to a Rayleigh distribution. This is to be expected on theoretical grounds. A.

534.4

2205. PREFERRED FREQUENCIES FOR ACOUSTICS. R.W.Young.
J. Acoust. Soc. Amer., Vol. 29, No. 10, 1144-5 (Oct., 1957).

A plea is made that the centre frequencies of both octave and one third octave filters should be chosen from the "preferred number" series, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000 c/s etc., 125, 250, 500 and 1000 c/s being the frequencies recommended for the octave intervals. H.D.Parbrook

534.41.07

2206. PIEZO-OPTIC FREQUENCY ANALYZER. T.Ogawa.
J. Acoust. Soc. Amer., Vol. 30, No. 1, 46-7 (Jan., 1958).

A new frequency analyser using a set of ADP crystal resonators is described. The signal to be analysed is applied to the electrodes of the crystals, which have different resonance frequencies. The crystal is placed between crossed polarizers, and the existence of the signal component is observed as the brightness of the beam coming through the crystal with the corresponding resonance frequency. A.

534.6

2207. ULTRASONIC OUTPUT POWER MEASUREMENTS IN LIQUIDS. G.E.Henry.
I.R.E. Trans Ultrasonics Engng, No. PGUE-6, 17-31 (Dec., 1957).

"Gross acoustic power transfer" is defined as the time rate of delivery of acoustic energy by a transducer to a selected liquid load. This quantity is related to, but should not be confused with, the power density, the intensity, the energy density, and the gross acoustic output from the transducer. To determine gross acoustic power transfer, one can (1) Make a sound pressure plot, utilizing a suitable hydrophone in a free field, convert to power, and integrate (2) Determine the rate at which sound energy is degraded to heat energy (3) Measure acoustic radiation force. Of these, the last is the preferred method if the lateral dimensions of the transducer are large compared to the wavelength. If the sound is beamed vertically upward, one can utilize a radiation pressure float which balances the upthrust of acoustic radiation force against the downward force of gravity. Such a float assumes an equilibrium position of partial immersion in the liquid. The preferred design eliminates any need for external guides or constraints: the float can be made self-centring. Care is needed in interpreting results, but the method is basically reliable and practical. A.

534.612.4 : 621.395.61

2208. METHODS FOR THE ABSOLUTE STANDARDIZATION OF MICROPHONES IN THE DEPARTMENT OF ACOUSTICS OF THE C.N.E.T. P.Riety
Ann. Télécomm., Vol. 13, No. 1-2, 16-34 (Jan.-Feb., 1958).
In French.

A description is given of the methods in use at the Laboratoire d'Essais du Conservatoire National des Arts et Métiers, in the Acoustic Department of the C.N.E.T. The various methods described include the following: (1) cavity methods — pistonphone and thermophone; (2) hydrodynamic methods — Rayleigh disk in resonant tube; (3) direct methods — electrostatic grid-membrane, and reciprocity. The techniques of measurement are discussed and a comparison is made between the different methods of measurement.
A.B.Wood

534.614

2209. ON THE MEASUREMENT OF ULTRASONIC VELOCITY IN SOLIDS. J.Williams and J.Lamb.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 308-13 (April, 1958).

A new method has been developed for the accurate measurement of the velocity of compressional waves in solid specimens. This is based on the cancellation of a travelling wave-train, which has undergone reflection at the ends of the specimen, by a second wave-train launched from the same transducer. A description is given of the experimental system employed. A correction must be made for the phase shift which occurs when the ultrasonic signal is reflected at the interface between specimen and transducer. A theoretical study of the effects of the transducer and coupling film shows that the correction is a function of the resonant frequency of the transducer and of the ratio of acoustic impedance of the transducer to that of the specimen. The application of the correction enables the velocity of propagation to be determined to wihtin 1 in 10^4. A.

534.614

2210. SING-AROUND ULTRASONIC VELOCIMETER FOR LIQUIDS. M.Greenspan and C.E.Tschiegg.
Rev. sci. Ihstrum., Vol. 28, No. 11, 897-901 (Nov., 1957).

A "sing-around" velocimeter of high stability and precision was developed and tested. The instrument, which is of the fixed-path type, automatically measure and/or records the speed of sound in non-dispersive liquids. Stabilities of about 50 p.p.m. over a 24 hr period can be achieved. A.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85

534.78

2211. EFFECT OF NOISE AND FILTERING ON SPEECH INTELLIGIBILITY AT HIGH LEVELS. I.Pollack and J.M.Pickett.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1328-9 (Dec., 1957).

The effects of high sound-levels on wide-band speech in noise roughly parallel the effects of high levels on filtered speech. The Articulation Index (AI) concept encompasses both findings if it is assumed that the effect of high sound-levels is to produce an effective change in AI. A.

534.781 : 534.83

2212. MASKING OF SPEECH BY NOISE AT HIGH SOUND LEVELS. I.Pollack and J.M.Pickett.
J. Acoust. Soc. Amer., Vol. 30, No. 2, 127-30 (Feb., 1958).

Speech intelligibility was examined at high noise levels for a range of speech and noise spectra. Over a wide range of conditions, deterioration of speech intelligibility was observed with a constant speech-to-noise (S/N) ratio at high noise levels. Little change in intelligibility was observed for over-all speech levels to 130 dB in the absence of background noise. Control tests ruled out distortion within the equipment as the factor associated with the loss of speech intelligibility. A.

534.781 : 534.83

2213. LIMITS OF DIRECT SPEECH COMMUNICATION IN NOISE. J.M.Pickett.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 278-81 (April, 1958).

Person-to-person tests of sentence intelligibility were carried out in low frequency and white noise at noise levels ranging from 85 to 118 dB. Talkers attained shouting levels of vocal effort but the maximum tolerable noise levels for 90% sentence intelligibility and 1 m between talker and listener were estimated to be 95 dB for white noise and 105 dB for low-frequency noise. A.

534.781 : 534.83

2214. SPEECH INTELLIGIBILITY AT HIGH NOISE LEVELS: EFFECT OF SHORT-TERM EXPOSURE. I.Pollack.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 282-5 (April, 1958).

Successive word intelligibility tests were executed at a constant S/N ratio over a 13-min period for a range of white noise levels between 45 and 130 dB. Speech intelligibility declined over the test period as a result of continued exposure to noise levels of 115 dB and higher. Interactions among different noise levels on successive tests, as evidenced by speech intelligibility scores in noise, was minimal when the noise levels were separated by less than 80 dB. A.

534.781 : 534.83

2215. INTERAURAL EFFECTS UPON SPEECH INTELLIGIBILITY AT HIGH NOISE LEVELS. I.Pollack and J.M.Pickett.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 293-6 (April, 1958).

The role of interaural effects upon speech intelligibility was examined at high noise levels. Over a wide range of conditions, a "mixed" listening condition (speech and noise to one ear and noise alone to the other ear) produced substantially lower intelligibility scores than monaural or binaural presentation of both speech and noise. The results are interpreted in terms of the interaction between the intelligibility of speech cross-conducted to the other ear and the apparent localization in space of the speech and noise. A.

534.784

2216. NASALIZATION OF VOWELS IN RELATION TO NASALS. S.Hattori, K.Yamamoto and O.Fujimura.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 267-74 (April, 1958).

The principal characteristic features of nasalization of vowels are (1) a dull resonance around 250 c/s , (2) an antiresonance at about 500 c/s, (3) comparatively weak and diffuse components which fill the valleys between the formants. Features (1) and (3) are commonly found also during the period of oral closure of nasal constants, (3) in this case being influenced by the antiresonance of the oral cavity. The feature (3) affected by "antiformants" carries information about the tongue position during oral closure. If the nasal passage is stopped at the nostrils when nasalized vowels are pronounced, features (1) and (3) disappear, and the frequency of selective attenuation (2) is lowered. Some French and Japanese nasalized vowels have been examined and interpreted, applying the results obtained in the research. A.

534.843

2217. ACOUSTICAL FIELD AT NORMAL MODES IN ROOMS. T.S.Korn and R.Van de Plas.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1267-70 (Dec., 1957).

The physical form of the acoustical field at normal complex modes in rooms can be represented as a set of elementary curvilinear ducts, each carrying a single stationary wave, satisfying individually the boundary conditions at the walls. In spite of the differences in their lengths, all the ducts resonate at the same nominal frequency, the differences in their flares adjusting the phase-velocity along their axes. This theory is confirmed by the analysis derived from the theory of horns. An experiment on the computed model of the duct yielded, with good accuracy, the calculated frequency of resonance. A.

534.846

2218. STUDIO FOR LISTENING TESTS. L.O.Dolanský.
J. Acoust. Soc. Amer., Vol. 30, No. 3, 175-81 (March, 1958).

The design, construction, acoustical testing, and articulation testing of a listening studio, giving reasonably constant listening conditions, is described. The reverberation time was measured by several methods, and was found to be equal to about 0.5 sec. A comparison of the individual results is presented. A.

OPTICS. RADIATION. SPECTRA

535.317

2219. IMAGE SYNTHESIS AND LENS RESPONSE USING SPOT DIAGRAMS. R.E.Keim and N.S.Kapany.
J. Opt. Soc. Amer., Vol. 48, No. 5, 351-3 (May, 1958).

A simple shadowgraph is used to measure the square-wave response of a lens system from its computed spot diagrams. Some fundamental aberrations are studied. Images of a silhouette test object are synthesized and compared to those produced by the lens system itself. A.

535.317

2220. A FILTER FOR IMPROVING ABERRATED OPTICAL IMAGES AND ITS USE AS A DOUBLE OR TRIPLE FOCUS FILTER. J.Tsujiuchi.
Rev. Opt., Vol. 37, No. 1, 1-10 (Jan., 1958). In French.

Phase and amplitude filters, comprising elements of varying transmission obtained from Twyman—Green interferograms and elements partly covered by a $\lambda/2$ phase-retarding layer, were designed to effect partial correction of the wavefront aberration of an objective. It was found that the decrease in Strehl definition on defocusing was less marked on using the filters. In some cases actual increases in definition could be obtained, resulting in more than one plane of focus. W.Weinstein

535.317.2

2221. A CLASS OF APLANATIC OPTICAL SYSTEMS. A.K.Head.
Proc. Phys. Soc., Vol. 71, Pt 4, 546-51 (April, 1958).

An arbitrary centred optical system is followed by two aspherical mirrors which are such that the complete system is exactly aplanatic. It is shown that the equations specifying these mirrors can be reduced to a first-order linear differential equation and so the solution involves two quadratures. If these integrals can be evaluated then the mirrors can be specified exactly. If the arbitrary optical system is axially stigmatic then a particular solution of the differential equation can be found by inspection and the solution then involves only one quadrature. As an example the combination of two aspherical mirrors following a parabolic reflector to form an aplanatic telescope is solved exactly. A.

535.322.4 : 535.414

PRINCIPLE OF AN INTERFERENCE REFRACTOMETER. See Abstr. 1628

535.323

2222. REFRACTIVE INDEX OF SYNTHETIC SAPPHIRE. I.H.Malitson, F.V.Murphy, Jr and W.S.Rodney.
J. Opt. Soc. Amer., Vol. 48, No. 1, 72-3 (Jan., 1958).

Reports measurements of the refractive index over the entire region 0.2-6 microns. Values are quoted at 19°C and 24°C and the thermal coefficient of the index is given. R.W.Fish

535.325

2223. REFRACTIVITY OF AIR IN THE NEAR INFRARED. D.J.Schlueter and E.R.Peck.
J. Opt. Soc. Amer., Vol. 48, No. 5, 313-15 (May, 1958).

Measurements are reported for the refractive index of air in the infrared up to 2 microns. These are both absolute and relative in nature, the latter being more precise. It is concluded that the measurements support the validity of Edlen's refractivity formula in this region. A.

535.33 : 530.145

RELATIVISTIC DOUBLETS OF SPECTRAL LINES. See Abstr. 2146

535.33.07

2224. A TUNEABLE MICROWAVE CAVITY FOR EXCITATION AT 2425 Mc/s OF AN OPTICAL SPECTROSCOPIC SOURCE. L.Bovey.
Spectrochimica Acta, Vol. 10, No. 4,432-3 (1958).

A quartz tube source, containing the sample whose spectrum is required, is held at one end of a section of waveguide and the microwave radiation is fed in at the other. Tuning plungers are adjusted for maximum light output. A photograph of the apparatus is included. L.Bovey

535.33.07 : 536.521 : 537.312.5

2225. APPLICATION OF SILVER SULPHIDE PHOTOELECTRIC CELLS WITH A BARRIER LAYER TO ABSOLUTE SPECTROPHOTOMETRY AND PYROMETRY. II. METHOD OF APPLICATION OF A S.S.P.C. [SILVER SULPHIDE PHOTOELECTRIC CELL] TO ABSOLUTE SPECTROPHOTOMETRIC AND PYROMETRIC MEASUREMENTS. G.F.Sitnik.
Astron. Zh., Vol. 34, No. 6, 887-98 (1957). In Russian with summary in English.

Changes in the sensitivity of eight different cells, manufactured in the U.S.S.R., with time and temperature were measured using the method described in Pt I (Astron. Zh., Vol. 34, No. 3, 1957) and are now reported. It was found possible to measure weak luminous fluxes, such as are met with in spectrophotometric practice, with an accuracy of 0.5-0.8% during a long series of absolute measurements. S.Chomet

535.33.07

2226. CALIBRATION OF PRISM SPECTROMETERS FROM 1300-2100 cm^{-1}. L.H.Jones.
J. chem. Phys., Vol. 27, No. 5, 1229-30 (Nov., 1957).

The author gives small corrections (up to 0.3 cm^{-1}) for some of the water bands he has previously recommended (Abstr. 5782/1956) for calibration purposes. G.F.Lothian

535.33.07

2227. CALIBRATION OF INFRARED PRISM SPECTROMETERS. D.A.Dows.
J. Opt. Soc. Amer., Vol. 48, No. 1, 73 (Jan., 1958).

Some of the wavenumbers given by Downie et al (Abstr. 232/1954) for calibration of a LiF prism are corrected; he had not taken account of the fact that the isotopic structure of the HCl lines near 3000 cm^{-1} is not resolved by this prism. G.F.Lothian

535.33.07

2228. FAR INFRARED SPECTROGRAPH FOR USE FROM THE PRISM SPECTRAL REGION TO ABOUT 1 mm WAVELENGTH. H.Yoshinaga, S.Fujita, S.Minami, A.Mitsuishi, R.A.Oetjen and Y.Yamada.
J. Opt. Soc. Amer., Vol. 48, No. 5, 315-23 (May, 1958).

The mounting is of the Czerny—Turner type. The radiation sources are a heated platinum strip used in the short-wave region and a high-pressure mercury lamp used in the long-wave region. Golay cells with diamond or quartz windows are used as detectors. Holders for filters to eliminate short-wave radiation and for reflection or transmission samples are designed for convenient use. Special chambers provide optical paths for long gas-cells and provide holders for small solid samples. All parts of the optical system are in a vacuum tank and are remote-controlled. Spectra are automatically recorded on a strip-chart recorder. Spectra in the region from 18 microns to about 1 mm, obtained with six echelette gratings, are shown. Reproducibility of wavelength settings is one part in 5000. Resolution of better than 0.5 cm^{-1} throughout the entire spectral region has been achieved. A.

535.33.07

2229. A MONOCHROMATOR FOR ULTRAVIOLET MICROSPECTROMETRY. H.Glubrecht.
Naturwissenschaften, Vol. 45, No. 2, 33 (1958). In German.

Describes a constant-deviation monochromator with focusing by quartz lenses and dispersion by two 30° quartz prisms. Wavelengths are varied by rotating a plane mirror placed between the prisms. It has high transmission and the amount of scattered radiation is small. G.F.Lothian

535.331/.332

2230. PRELIMINARY MEASUREMENTS OF SOME WAVELENGTHS OF KRYPTON 86 AND MERCURY 198 LINES. K.M.Baird and D.S.Smith.
J. Opt. Soc. Amer., Vol. 48, No. 5, 300-1 (May, 1958).

Vacuum wavelength values for some of the lines in the spectra of Kr^{86} and Hg^{198} have been derived by comparison with a Michelson type Cadmium lamp, by using a 67.5 mm Fabry—Perot etalon as the intermediary. The same lines have been intercompared by means of a Twyman—Green interferometer, referring to the Hg^{198} green line wavelength as 5462.2704A. The half-widths of the lines were also measured. A.

535.331

2231. ON THE SIMILARITY OF THE COHERENCE TIMES MEASURED BY MAGNETIC RESONANCE AND MAGNETIC DEPOLARIZATION FOR THE 202 ISOTOPE OF MERCURY.
J.P.Barrat.
C.R. Acad. Sci. (Paris), Vol. 244, No. 23, 2785-8 (June 3, 1957). In French.

It is shown for Hg^{202} that the classical optical method of magnetic depolarization of resonance radiation leads to substantially the same value for coherence time and its variation with molecular concentration as for the modern magnetic resonance method. R.W.Nicholls

535.331

2232. MEASUREMENT, BY MAGNETIC RESONANCE, OF "COHERENCE TIME" ON THE ISOTOPES Hg^{199} AND Hg^{201}.
F.Boutron, J.P.Barrat and J.Brossel.
C.R.Acad.Sci. (Paris), Vol. 245, No. 25, 2250-3 (Dec. 16, 1957).

Coherence times for the 6^3P_1 level of Hg^{199} and Hg^{201} were measured as a function of concentration by magnetic resonance. Coherence times for both isotopes tend asymptotically to the lifetime 1.18×10^{-7} sec at lowest concentrations ($5 \times 10^{11}/cm^3$). 17% (Hg^{201}) and 42% (Hg^{199}) rises in coherence times with increasing concentration to $2 \times 10^{14}/cm^3$ were observed. Good agreement with theory was obtained. R.W.Nicholls

535.332

2233. EMISSION LINES FROM PREIONIZED LEVELS IN KRYPTON AND XENON. M.Thekaekara and G.H.Dieke.
Phys. Rev., Vol. 109, No. 6, 2029-31 (March 15, 1958).

In strong rare-gas discharges at relatively high pressures many hitherto unrecorded lines appear which are classified as transitions from preionized p' and f' levels to normal stable levels. Twenty-four such lines were found in the spectrum of Kr I and thirty in the spectrum of Xe I. The intensity of these lines may be used to measure the ion density. A.

535.333

2234. ULTRAVIOLET SPECTRUM OF AIR AT 5750° K.
W.H.Wurster and H.S.Glick.
J. chem. Phys., Vol. 27, No. 5, 1218-19 (Nov., 1957).

Emission and absorption spectra of air heated in a shock tube show the γ bands of NO. A.G.Gaydon

535.34

2235. ABSORPTION SPECTRA OBTAINED USING COLD LIGHT-SOURCES. B.I.Stepanov and Ya.S.Khvashchevskaya.
Dokl. Akad. Nauk SSSR, Vol. 116, No. 4, 588-90 (1957). In Russian.

The usual apparatus employed in absorption spectra studies consists, essentially, of a specimen under investigation interposed between the source and the detector. It is shown that in the infrared region it is important to consider the thermal radiation emitted by the detector and the container in which the specimen is placed. In some cases the net radiant energy will flow from the detector to the source. In such cases the detector readings can still be used to obtain the absorption spectrum of the specimen under investigation. Some simple formulae are derived which can be used in such "negative radiation" studies. S.Chomet

535.34.07

2236. DOUBLE-BEAM INFRARED MICROSPECTROMETER.
M.A.Ford, W.C.Price, W.E.Seeds and G.R.Wilkinson.
J. Opt. Soc. Amer., Vol. 48, No. 4, 249-54 (April, 1958).

A double-beam infrared microspectrometer which is particularly suitable for the examination of fibres, small crystals and micro-samples is described. It is based on a double-beam-in-time system and involves a precision stage movement which inserts sample and reference alternately into the beam. The merits of this system are discussed with reference to other systems which have been developed for infrared microspectrometry. A.

535.343

2237. ABSORPTION SPECTRA OF MOLTEN SALTS.
B.R.Sundheim and J.Greenberg.
J. chem. Phys., Vol. 28, No. 3, 439-41 (March, 1958).

The ultraviolet absorption spectra of a variety of molten salts were determined. Generalizations about the character of such spectra are made and certain implications about the structure of the liquids are examined. A.

535.343

2238. INFRARED SPECTRUM OF BROMINE IN BENZENE.
W.B.Person, R.E.Erickson and R.E.Buckles.
J. chem. Phys. Vol. 27, No. 5, 1211-12 (Nov., 1957).

This paper confirms the suggestion of Collin and D'Or (Abstr. 3587/1955) that a narrow band near 300 cm^{-1} should be attributed to a benzene–bromine charge transfer complex, since the integrated absorption varies with dilution in ethylene dichloride in accordance with the equilibrium constant of the complex. G.F.Lothian

535.343 : 533.337

2239. STARK EFFECT AT 2.0 AND 1.2 MILLIMETERS WAVELENGTH: NITRIC OXIDE. C.A.Burrus and J.D.Graybeal.
Phys. Rev., Vol. 109, No. 5, 1553-6 (March 1, 1958).

Stark-effect measurements were made for the first time in the 1-2 mm wave region. Results of Stark-effect measurements on the $J = \frac{1}{2} \rightarrow \frac{3}{2}$ and $J = \frac{3}{2} \rightarrow \frac{5}{2}$ transitions of the $^2\Pi_{1/2}$ ground state of $N^{14}O^{16}$, falling at 2.0 and 1.2 mm, respectively, are reported, and are shown to fit closely existing theory; the electric dipole moment of NO in the ground state is found to be 0.158 ± 0.006 Debye unit. A.

535.343 : 533.337

2240. THEORY OF THE STARK EFFECT OF THE NO MOLECULE.
M.Mizushima.
Phys. Rev., Vol. 109, No. 5, 1557-9 (March 1, 1958).

Since the NO molecule has a finite electronic angular momentum $\hbar/2$ along the molecular axis in its ground state, the Stark effect of this molecule is very large, the molecule being effectively a symmetric top molecule rather than a diatomic molecule. The calculation is made both for weak-field and strong-field cases. An experiment by Burrus and Graybeal has been done for weak fields and gives $\mu = 0.158$ Debye unit. The dielectric constant of this molecule is also discussed and it is shown that the ordinary Langevin–Debye formula can be used with the effective dipole moment $\mu_{eff} = 0.971\mu$. A.

535.343

2241. MICROWAVE SPECTRA OF THE Tl, In, AND Ga MONOHALIDES. A.H.Barrett and M.Mandel.
Phys. Rev., Vol. 109, No. 5, 1572-89 (March 1, 1958).

A high temperature spectrometer was used to study the rotational spectra of the gallium, indium, and thallium monohalides. The molecular constants are

	B_e (Mc/s)	α_e (Mc/s)	r_e (A)
$Tl^{205}F$	6689.97 ± 0.06	44.97 ± 0.08	2.0844 ± 0.0001
$Tl^{205}Cl^{35}$	2740.05 ± 0.02	11.90 ± 0.01	2.4848 ± 0.0001
$Tl^{205}Br^{79}$	1293.89 ± 0.01	3.927 ± 0.005	2.6181 ± 0.0001
$Tl^{205}I^{127}$	814.479 ± 0.015	1.985 ± 0.005	2.8135 ± 0.0001
$In^{115}Cl^{35}$	3269.47 ± 0.14	15.35 ± 0.15	2.4011 ± 0.0001
$In^{115}Br^{79}$	1670.14 ± 0.02	5.706 ± 0.01	2.5432 ± 0.0001
$In^{115}I^{127}$	1104.95 ± 0.45	3.117 ± 0.015	2.7539 ± 0.0009
$Ga^{69}Cl^{35}$	4493.73 ± 0.19	23.27 ± 0.12	2.2017 ± 0.0001
$Ga^{69}Br^{79}$	2481.99 ± 0.04	9.74 ± 0.03	2.3525 ± 0.0001
$Ga^{69}I^{127}$	1706.86 ± 0.04	5.67 ± 0.15	2.5747 ± 0.0001

The quadrupole coupling constants determined in this experiment are related to the molecular bond and the role of s–p hybridization in the molecular bond is discussed. A.

535.343

2242. MICROWAVE SPECTRA OF MOLECULES EXHIBITING INTERNAL ROTATION. III. TRIMETHYLAMINE.
D.R.Lide, Jr and D.E.Mann.
J. chem. Phys., Vol. 28, No. 4, 572-6 (April, 1958).

For Pt II, see Abstr. 128 (1958). The first two rotational transitions of trimethylamine were studied. The spectrum of the ground vibrational state follows a symmetric-rotor pattern with the following constants: $B_0 = 8720.86$ Mc/s, $D_J = 5$ kc/s, $eqQ(N^{14}) = -5.47$ Mc/s, $\mu = 0.612$ D. If a reasonable structure is assumed for the CH_3 groups, the framework structure is found to be: $r_{CN} = 1.472$ A, $\angle CNC = 108.7°$. The satellite lines which surround each ground-state transition have been assigned to excited vibrational states. Relative intensity measurements on these satellites lead to frequencies of 263 cm^{-1} and 290 cm^{-1} for the torsional modes of species A_2 and E, respectively. These frequencies are interpreted in terms of a simplified model for the torsional motions of the methyl groups. The implications of the results are discussed. A.

535.343

2243. MICROWAVE ABSORPTION IN METHYL HALIDES. Krishnaji and G.P.Srivastava.
Phys. Rev., Vol. 109, No. 2, 1560-3 (March 1, 1958).

It is confirmed that the absorption of 3-cm waves in methyl chloride and methyl bromide is entirely due to the inversion transition at zero wave number. In the J band the additional absorption observed is assigned to the resultant effect of various rotational transitions of the molecule. In this connection it was found that the following average values of the pressure-broadening parameter $\Delta\nu$ give the best fit to the experimental results. Methyl chloride: $\Delta\nu = 0.5067$ cm^{-1}/atm (rotational line); $\Delta\nu = 0.124$ cm^{-1}/atm (inversion line). Methyl bromide: $\Delta\nu = 0.633$ cm^{-1}/atm (rotational line); $\Delta\nu = 0.122$ cm^{-1}/atm (inversion line). It is suggested that a more accurate fit can be obtained if the distribution of relaxation times for the inversion line and the shift of rotational lines to lower wavenumbers is taken into account. Study of the temperature dependence of the absorption coefficient for methyl chloride in the 3 cm region indicates that, at low pressure, it varies as T^{-3}. This temperature variation of the absorption coefficient confirms that $\Delta\nu \propto 1/T$, as predicted by Anderson's or Margenau's theory of pressure broadening. A.

535.343.9 : 535.375.54

2244. RESEARCHES ON THE RAMAN SCATTERING SPECTRUM OF WATER IN HYDRATED CRYSTALS. A.Weil-Marchand.
Ann. Phys. (Paris), Vol. 2, No. 11-12, 881-927 (Nov.-Dec., 1957). In French.

The orientation of the water molecules in the crystalline lattice and the deformation undergone by the molecules were determined from Raman spectral results in the following compounds: $K_2HgCl_4.H_2O$, $SrCl_2.6H_2O$, $CaCl_2.6H_2O$, $AlCl_3.6H_2O$, $BaCl_2.2H_2O$, $NaBr.2H_2O$, $ZnSiF_6.6H_2O$, $Mg(ClO_4)_2.6H_2O$, $LiClO_4.3H_2O$, $Li_2SO_4.H_2O$, and $(COOH)_2.2H_2O$. Theoretical and experimental results are fully tabulated and detailed interpretations made using X-ray diffraction data on the crystalline structures. G.I.W.Llewelyn

535.345 : 535.37 : 537.311.33

2245. DISCUSSION OF SOME OPTICAL AND ELECTRICAL PROPERTIES OF Cu_2O. J.Bloem.
Philips Res. Rep., Vol. 13, No. 2, 167-93 (April, 1958).

From known optical (absorption, luminescence) and electrical (carrier concentration and mobility, the Hall effect, conductivity) data on Cu_2O a band scheme is constructed for this semiconductor. The equilibria between the solid constituents and a vapour containing oxygen are calculated. From these data the conductivity and the concentrations of the various defect centres can be evaluated for Cu_2O at high temperatures in equilibrium with an applied partial pressure of oxygen. The results are shown to be in good agreement with experiment. The optical and electrical properties after quenching, however, do not correspond to the model mentioned above. If association between defects is considered during the cooling process, the optical properties can be explained. As to the Hall-effect data, the occurrence of chemisorption of oxygen during quenching must also be taken into account, especially if well-conducting surface layers are formed, which appears to be favoured at the lower oxygen pressures, whereas at high oxygen pressures conduction through the bulk of the crystallites prevails. The intermediate region of mixed conduction is characterized by a very low effective mobility. A.

535.371

2246. ON A NEW CLASS OF SOLID PHOTOLUMINESCENT MATERIALS. S.Schlivitch.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2047-8 (Dec. 4, 1957). In French.

$MnCl_2$ crystallized with pyridine from solution, gave intense red or green luminescence when irradiated with ultraviolet light, depending on concentration and temperature. Similar results were obtained with quinoline instead of pyridine. CuI and pyridine produced a green and yellow emission, an orange emission was obtained with CuI and quinoline. J.Franks

535.371

2247. ON THE THEORY OF CONCENTRATION QUENCHING OF FLUORESCENCE OF SOLUTIONS. B.Ya.Sveshnikov.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 2, 274-6 (1957). In Russian.

535.371 : 537.312.5

2248. FLUORESCENCE AND PHOTOCONDUCTION OF SILVER-ACTIVATED CADMIUM SULPHIDE. W.van Gool.
Philips Res. Rep., Vol. 13, No. 2, 157-66 (April, 1958).

Several Ag-activated CdS phosphors are described, with Ga or Cl as coactivator. The fluorescence at low temperature shows two bands with maxima at 6200 A and 7300 A. High Ag concentration and low coactivator concentration promote the short-wave emission. Phosphors with equal concentrations of activator and coactivator show only the long-wave emission. Optimal photoconduction and low dark-current are only found with an activator—coactivator ratio slightly greater than one. A series of mixed crystals (Zn,Cd)S activated with Ag shows clearly the relation between 6200 A emission in CdS and a 3880 A emission in ZnS, and also between the 7300 A band in CdS and the normal blue Ag band at 4350 A in ZnS. The behaviour of the Ag bands in CdS is quite similar to those of Cu in ZnS. These results show that the conclusions drawn by Lambe and Klick regarding the position of the impurity level responsible for the 6200 A Ag emission in CdS cannot be applied to the normal blue Ag emission in ZnS:Ag. These results led to an improvement of the properties of a red colour-television phosphor. A.

535.371

2249. LUMINESCENCE OF Z CENTERS IN KCl:Sr CRYSTALS. E.J.West and W.D.Compton.
Phys. Rev., Vol. 108, No. 3, 576-9 (Nov. 1, 1957).

A search was made for emissions that are characteristic of the Z_1 and Z_2 centres in additively coloured crystals of KCl containing Sr. No emission was found for the Z_1 centre, but the Z_2 centre was found to emit at 1.14 μ at 77°K. The results of a study of the polarization of the emission of the Z_2 centre with polarized exciting-light indicate that this centre is of high symmetry. An investigation of the transfer of energy between centres that have been formed by irradiating with F light leads to the conclusion that these centres (i.e. F, Z_1, R_1, R_2, M, and a centre with absorption at 860 mμ) are formed in the neighbourhood of each other. A.

535.371

2250. ENERGY STORAGE IN ZnS AND ZnCdS PHOSPHORS. H.Kallmann and E.Sucov.
Phys. Rev., Vol. 109, No. 5, 1473-8 (March 1, 1958).

The deficiency area above a rise curve of fluorescence due to excitation by high-energy electrons is a measure of the total amount of energy stored in traps. In order to investigate the rate of decay of this energy, rise curves were taken for six phosphors of various luminescent properties and activation after various dark decay periods following excitation to equilibrium and after de-excitation by exposure to infrared light and heat. For all phosphors the trap concentration was found to be of the order of 10^{18}/cm^3 independent of the type of activator. In addition, the rates of decay of stored energy were determined and were found to be similar; from 20% to 60% of the energy remained in the phosphors after 1 week. This slow rate of decay is explained by predominant retrapping in traps of various depths. The areas under curves of phosphorescent emission were compared to the deficiency areas above rise curves taken immediately after the end of decay. For four of the phosphors these two areas are nearly equal to each other. One phosphor, especially activated with Ni and with practically no phosphorescence exhibited, however, a rate of energy decay similar to the phosphorescent phosphors. This means that the decay of stored electrons can take place radiatively and/or nonradiatively and that the rate for both processes is of the same order of magnitude. The areas under curves of visible light stimulated by infrared irradiation were compared with areas above rise curves taken immediately after the end of stimulation. If all stored electrons were released radiatively, these two areas would be equal. For only one phosphor (specially Pb activated ZnS) was this the case. All others exhibited only from 0.6% to 5% radiative recombinations. Thus the light sum under a stimulation curve does not give a true picture of the trap population. A.

535.373 : 537.312.5

PHOSPHORESCENCE OF CALCIUM TUNGSTATE. See Abstr. 1703

535.377 : 539.2

THERMOLUMINESCENCE IN X-RAY COLOURED KCl CRYSTALS. See Abstr. 2035

535.3

2251. HIGH-SPEED, DIRECT-READING GLOSSMETER. J.G.Schreckendgust and D.M.Gowing.
J. Opt. Soc. Amer., Vol. 48, No. 4, 241-5 (April, 1958).

A high-speed, direct reading glossmeter which measures specular reflectance at 20°, 60°, and 85° angles has been developed. This instrument employs a direct parallel beam at each viewing angle, and utilizes an efficient optical system and compensated barrier cell circuits to activate a stable positioning servomechanism. The barrier cell circuitry combined with adjustable receptor apertures provide good linearity. Gloss values in A.S.T.M. units are read directly from the counter dial to the nearest 0.1 unit. Experience with glass, ceramic, and organic polymer films on flat surfaces has shown that repetitive measurements can be made five times faster and with greater reproducibility than with commercially available instruments. The eighteen instruments in current use demonstrate its suitability as both a laboratory and production control instrument. A.

535.393 : 539.234

2252. INFLUENCE OF PURITY, SUBSTRATE TEMPERATURE, AND AGING CONDITIONS ON THE EXTREME ULTRAVIOLET REFLECTANCE OF EVAPORATED ALUMINUM. G.Hass, W.R.Hunter and R.Tousey.
J. Opt. Soc. Amer., Vol. 47, No. 12, 1070-3 (Dec., 1957).

An investigation was made of the effects of Al purity, substrate temperature, ageing and u.v. irradiation on the reflectance of coatings of Al deposited on glass by evaporation. The wavelength range covered was from 900 to 2200 A. Data are presented supporting the following conclusions. Whenever Al mirrors or diffraction gratings of the highest reflectance are required for use in the extreme u.v., it is important that they be produced from the purest grade of Al (99.99%) on a non-heated substrate. Growth of the oxide should be retarded, so far as possible, by storing the coatings in a dessicator, rather than leaving them exposed to normal room air. If left in an unevacuated spectrograph some drying agent should be introduced. Intense u.v. irradiation should be avoided as much as possible, especially if water vapour is present. For use at wavelengths below 1100 A heavily anodized Al may be preferred to fresh Al. See also Abstr. 3167 (1956). A.

535.393.08

2253. CALORIMETRIC METHOD OF DETERMINING OPTICAL CONSTANTS OF METALS IN THE INFRARED REGION OF THE SPECTRUM AT LOW TEMPERATURES. N.E.Alekseevskiĭ and E.V.Potapov.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 283-4 (1957). In Russian.

A preliminary report on an apparatus used to measure the optical constants of bismuth in the wavelength range 1-7 μ. The density of conduction electrons is found to be $N \cong 3 \times 10^{20}$ on the basis of the theory given by Ginzburg and Motulevich (Abstr. 1092/1956). S.Chomet

535.412

2254. PHASE SHIFT EFFECTS IN FRINGES OF EQUAL CHROMATIC ORDER. C.J.Koester.
J. Opt. Soc. Amer., Vol. 48, No. 4, 255-60 (April, 1958).

For the calculation of step heights or interferometer plate displacement three methods of analysis are discussed. A comprehensive expression is derived which requires knowledge of the phase shift on reflection. A simple expression, $2\Delta t = \lambda_1 \Delta\lambda/(\lambda_0 - \lambda_1)$, is shown to be exact under certain conditions. Here Δt is the step height, $\Delta\lambda$ the fringe shift, and λ_0, λ_1 are the wavelengths of adjacent fringes, $\lambda_0 > \lambda_1$. A method is introduced which does not require prior knowledge of the phase-shift dispersion. For one set of fringes an arbitrary integer, N, is selected and the function $\tau_N(\lambda)$ is found by plotting $N\lambda_0$ v. λ_0, $(N+1)\lambda_1$ v. λ_1, etc. For the set of shifted fringes the function $\tau_N(\lambda)$ is found similarly by plotting $N\lambda_0'$ v. λ_0', etc., where the fringe at λ_0' has the same order number as that at λ_0. It is shown that the vertical displacement between the two curves is a constant equal to twice the step height. Other uses of the tau function are described. If the tau function is linear with wavelength, the simple expression above can be used without error. A.

535.412

2255. MULTIPLE-BEAM FRINGE SHARPENING WITH THE SERIES INTERFEROMETER. D.Post.
J. Opt. Soc. Amer., Vol. 48, No. 5, 309-12 (May, 1958).

The parallel mirror Series Interferometer exhibits fringes that are qualitatively similar to the well-known multiple-beam fringes of two mirror interference systems. Contrary to the case of two mirror systems, however, no stringent restrictions on mirror separation or monochromatic purity of light source are involved, for the relative path lengths of interfering rays is independent of mirror separation. Thus, sharpened fringes can be employed for applications that require moderately large test zones, such as problems in fluid flow, thermal expansion, optics testing, etc. An experimental verification and analytical treatment are presented. The analysis yields an intensity-fringe order relationship that is effectively corroborated by experimental observations. A.

535.417 : 532.72

2256. MACH–ZEHNDER INTERFEROMETER FOR DIFFUSION MEASUREMENTS IN VOLATILE LIQUID SYSTEMS. C.S.Caldwell, J.R.Hall and A.L.Babb.
Rev. sci. Instrum., Vol. 28, No. 10, 816-21 (Oct., 1957).

The Mach–Zehnder-type interferometer has not previously been employed for the study of diffusion in liquid systems. For systems whose components are volatile organic solvents a diffusion cell of novel design was constructed. The diffusiometer was checked using the system sucrose–water at 25°C and values of the diffusion coefficient found over six determinations are within 0.2% of the reported value. With volatile liquids, the accuracy claimed is only 1%, although duplicates usually agreed to within 0.5%. A.

535.417 : 536.24

2257. INTERFEROMETER USED TO STUDY TRANSIENT HEATING OF WATER. E.A.McLean, V.E.Scherrer, C.A.Nanney and C.E.Faneuff.
Rev. sci. Instrum., Vol. 29, No. 3, 225-8 (March, 1958).

Discusses the use of a Mach–Zehnder interferometer in a study of heat transfer in water. A derivation of the formula is given relating temperature change to fringe shift and a correction procedure is shown for end effects. Temperature distributions are determined for pulse-heated nichrome foils in water. With the experimental conditions used, a maximum temperature gradient of 280 deg C/cm was observed. A.

535.42 : 537.533.73

2258. A NEW FORMULATION OF SCALAR DIFFRACTION THEORY FOR RESTRICTED APERTURE. J.M.Cowley and A.F.Moodie.
Proc. Phys. Soc., Vol. 71, Pt 4, 533-45 (April, 1958).

A formulation for scalar problems in physical optics is presented. Approximations involve the neglecting of the obliquity factor and the dependence of amplitude on distance and the replacement of spherical by paraboloidal wavefronts. Expressions are obtained for wave-function in a multi-component system in terms of convolution integrals, the components of the system being described by functions of either direct of Fourier space. The formulation is equally applicable to light optics, electron microscopy or electron diffraction and permits interchange in the techniques of these disciplines. Some elementary examples of the application to thin lenses, and to periodic objects are given. A.

535.43

2259. NOTE ON KRISHNAN'S RECIPROCITY RELATION IN LIGHT SCATTERING. A.F.Stevenson.
J. appl. Phys., Vol. 28, No. 9, 1015-17 (Sept., 1957).

Krishnan's relation is deduced rigorously from Maxwell's equations when scattering by a single body is considered and an average overall orientation of the body is taken. When scattering by a large number of randomly-oriented particles is considered, Krishnan's relation holds true either if multiple scattering and the effect of the container walls are neglected, or if a certain symmetry condition is satisfied. Where this condition is not satisfied, deviations from Krishnan's relation may be expected at high concentrations. The desirability of extrapolating experimental results to zero concentration is emphasized. Relations analogous to Krishnan's are also deduced which do not require any averaging over orientations, but involve instead the interchange of the dielectric constant and magneti permeability, relative to the surrounding medium, at each point of the scattering system. A.

535.43.07 : 551.463

2260. NEPHELOMETER FOR THE MEASUREMENT OF VOLUME SCATTERING FUNCTION IN SITU. J.E.Tyler and W.H.Richardson.
J. Opt. Soc. Amer., Vol. 48, No. 5, 354-7 (May, 1958).

A submarine nephelometer has been built for use in measuring the volume scattering function of natural waters. Theory and construction details of the optical system are given, including pertinent

data for the photodetector used. The instrument is capable of measuring volume scattering function between angles of 20° and 170° in typical coastal waters. Results of preliminary tests with the instrument are given. A.

535.434

2261. INTERMOLECULAR CORRELATION IN LIGHT SCATTERING FROM DILUTE POLYMER SOLUTIONS.
A.C.Albrecht.
J. chem. Phys., Vol. 27, No. 5, 1014-23 (Nov., 1957).

The effects of intermolecular correlation on light scattered from flexible chain molecules are considered. The random flight model is treated correctly to the double contact approximation. Two smoothed density models are carried to the same approximation and comparisons are made. In every case a decrease of "apparent" A_2 with increasing angle of observation is predicted in qualitative agreement with experiment. A.

535.434

2262. SINGLE PARTICLE SCATTERING FUNCTIONS FOR LATEX SPHERES IN WATER. L.E.Ashley and C.M.Cobb.
J. Opt. Soc. Amer., Vol. 48, No. 4, 261-8 (April, 1958).

The angular distribution of intensity of light scattered by spherical particles whose relative index of refraction with respect to the surrounding medium is 1.20 has been computed for values of α (a size parameter = circumference of the particle divided by the wavelength of the incident beam) equal to 1.0, 2.0, 3.0, 5.0, 8.0, 10, 15, 20, 30, and 35. The results are presented in tabular form and give: (1) the intensities of the two incoherent, plane-polarized components of the scattered light; (2) one-half the sum of these two components, and (3) the real and imaginary parts of the complex functions from which the intensities are computed. Values are listed for angles of observation in the range 0° to 180°. Polar plots of one-half the sums of the two incoherent plane-polarized components versus angle are presented. A.

535.557

2263. NEW DATA RELATING TO THE ORIENTATION OF THE DOUBLE REFRACTION OF RAYS IN STREAMING SOLUTIONS OF POLYMERS. É.V.Frisman.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 1, 72-4 (1958). In Russian.

The magnitude of double refraction Δn, which is proportional to the difference of the main polarizabilities of the macromolecule, contains two terms, one of which is due to the proper (natural) anisotropy, while the other depends on shape. The role of double refraction due to shape was elucidated in previous papers for polystyrene in dioxane (Abstr. 7329/1956 and Dokl. Akad. Nauk SSSR, Vol. 115, No. 3, 491, 1957). The present paper deals with the peculiar dependence of the orientation angle on the velocity gradient. The results are graphed for the concentration range 0.1-0.7 g/100 cm^3. F.Lachman

535.563 : 538.164

2264. THE INFLUENCE OF PARAMAGNETIC RESONANCE SATURATION ON THE FARADAY EFFECT.
J.M.Daniels and H.Wesemeyer.
Canad. J. Phys., Vol. 36, No. 3, 405-6 (March, 1958).

A reduction in the Faraday effect for green light (λ = 5461 A) was observed in a single crystal of neodymium ethyl sulphate, at 1.5°K, when the total magnetic moment of the sample was reduced by saturation of the microwave transition at 9060 Mc/s in a field of about 1.7 kG. The experiment was done at several power levels and a progressive reduction in the Faraday effect was observed as the power level was increased. J.M.Baker

535.563

2265. ON THE ROTATORY DISPERSION OF PROTEIN AND DNA.
H.Murakami.
J. chem. Phys., Vol. 27, No. 6, 1231-7 (Dec., 1957).

The general formula of rotatory dispersion is presented from the viewpoint of Kirkwood's theory. This formula is then applied to the rotatory dispersion of protein. Under reasonable assumptions, the behaviour of the critical wavelength λ_C, which seems to be a measure of denaturation, may well be interpreted. The rotatory dispersion of DNA (deoxyribose nucleic acid) is also explained as the sensitive reflection of the structural characteristics of this molecule. In the case of the latter substance, special attention is focused on Condon's one-electron effect. A.

535.6.08 : 778.6

2266. VISUAL SELECTION OF COLOR FILM NEUTRALS.
R.W.Burnham.
J. Opt. Soc. Amer., Vol. 48, No. 4, 215-24 (April, 1958).

Neutral areas on colour film were selected by a visual colour matching technique as a basis for comparing real observers with the C.I.E. standard observer. Data from 29 observers show low precision of visual selection as compared to standard physical techniques, and possible deviance from the C.I.E. standard observer in the blue direction. A comparison of Stiles' tentative mean observer with the C.I.E. standard observer showed that the latter is the more representative of the real observers. A.

535.6.08 : 778.6

2267. PREPARATION OF COLOR-WEDGED FILM SAMPLES FOR USE IN A NEUTRAL SELECTOR. R.H.Morris.
J. Opt. Soc. Amer., Vol. 48, No. 4, 225-7 (April, 1958).

The development of an instrument for selecting visually neutral areas of photographic dye images (Abstr. 1638/1958), indicated desirability of film samples characterized by an equiluminous area with uniform colour gradients. The mathematical development of the technique for arriving at the required conditions for exposing the film sheets is given. Exposure conditions for a particular colour film and viewing illuminant are computed in an example. A.

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.81

2268. PRISMS FOR LAYING OUT ANGLES IN SURVEYING.
A.Tárczy-Hornoch.
Acta tech. Hungar., Vol. 19, No. 1-2, 127-54 (1957). In German.

Prisms giving accurate angles of 45°, 90° and 180° rotation of incident beams have many uses in surveying. A systematic account is given of the many forms of prism which give these angles after one or more reflections and refractions. Double prisms in which two beams are each deviated 45° are also described. R.W.Fish

535.81

2269. FURTHER CONSIDERATIONS ON THE SELECTION OF OPTICAL GLASSES IN APOCHROMATS. N.v.d.W.Lessing.
J. Opt. Soc. Amer., Vol. 48, No. 4, 269-73 (April, 1958).

An analytical proof for the method developed in Abstr. 9649 (1957) for the choice of glasses of an apochromatic system consisting of three lenses in contact with each other is given. Variation of the powers with small changes in the coordinates representing the glasses is discussed and it is found that the optical constants of the glasses must be determined accurately (to ± 0.000005 or better) for the selection of the best glasses. It is also shown how four glasses can be used to advantage in an apochromat. Finally the extension of the method to an apochromatic system which consists of three lenses separated by air spaces, is considered briefly. A.

HEAT

536.2.08

2270. METHOD FOR DETERMINING THERMAL CONDUCTIVITY AT HIGH TEMPERATURES. C.L.Longmire.
Rev. sci. Instrum., Vol. 28, No. 11, 904-6 (Nov., 1957).

A method has been developed for determining thermal conductivity by measuring temperatures at the centre of the faces of a rectangular rod which is heated electrically. Radiation of energy causes a difference in the temperatures of the short and long faces, and this difference is related to the thermal conductivity. The emissivity of the surface must be known. The method has been applied successfully to the measurement of the thermal conductivity of graphite at temperatures near 2500°K, when other standard methods failed. A.

536.212

2271. THE THERMAL CONDUCTIVITY OF TIN–INDIUM ALLOYS IN THE NORMAL STATE. C.A.Shiffman.
Proc. Phys. Soc., Vol. 71, Pt 4, 597-607 (April, 1958).

Measurements have been made of the thermal conductivity in the normal state of ten alloys of tin with from two to eight per cent indium, over the range from 2 to 20°K. The samples with less than 3% indium satisfy the relation $W = \rho_0/L_0T + \alpha T^3$ except at the lowest temperatures where a small lattice term lowers the thermal resistance. The more impure samples show a large lattice conductivity over the entire range. This is roughly parabolic below 4°K, but is linear in T from 5 to 16 or 17°K. The linear dependence is ascribed to scattering of phonons either by the local disorder in the lattice at the boundaries of mosaic domains or by stacking faults. A.

536.212 : 536.221

2272. THE THERMAL CONDUCTIVITY OF TELLURIUM.
Kh.I.Amirkhanov, G.B.Bagduev and M.A.Kazhlaev.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 6, 953-5 (1957). In Russian.

The thermal conductivity of polycrystalline tellurium was measured between 10°C and the melting point (approx. 450°); the thermal conductivity of liquid tellurium was measured between the melting point and 500°C. In the solid state the thermal conductivity appears to be rather insensitive towards changes in temperature. There is, however, a clear minimum at 250°C. In a theoretical analysis it is attempted to make an estimate of the contribution of phonons, positively charged "holes" and electrons to the thermal conductivity. It would appear that the first two contributions vary markedly with temperature but that their temperature coefficients are nearly equal and opposite. In the liquid state at the melting point, the thermal conductivity is approximately 10 times larger than in the solid state. Further increase in temperature reduces the thermal conductivity appreciably. R.Eisenschitz

536.212

2273. THE INFLUENCE OF ADDITION OF CHLORINE ON THE THERMAL CONDUCTIVITY OF SELENIUM.
G.M.Aliev and G.B.Abdullaev.
Dokl. Akad. Nauk SSSR, Vol. 116, No. 4, 598-600 (1957). In Russian.

Additions of Cl to 99.994% Se initially sharply reduce the thermal conductivity, κ, which reaches a minimum at ~ 0.03% Cl for both amorphous and crystalline Se. Though further addition of Cl raises κ, it does not approach the value for pure Se. The effects are interpreted in terms of phonon scattering. For pure Se, amorphous and crystalline, κ is given as 3.126×10^{-3} and 6.45×10^{-3} cal.cm^{-1}.sec^{-1}.deg^{-1}, respectively. C.H.L.Goodman

536.212

2274. THE EFFECT OF BROMINE ADDITIONS ON THE THERMAL CONDUCTIVITY OF SELENIUM.
G.B.Abdullaev and A.A.Bashshaliev.
Zh. tekh. Fiz., Vol. 27, No. 9, 1971-5 (1957). In Russian.

The apparatus used to measure the thermal conductivity, κ, with an error less than ±4% is described. Specimens with seven different Br contents (0.008 - 0.5 wt.%) were measured as well as pure Se (99.996%). The graphs of κ against Br content had similar shapes for amorphous and crystalline Se. The values of κ in 10^{-3} cal.(deg°C)$^{-1}$.cm^{-1}.sec^{-1} obtained for amorphous Se (at 27.5°C) and crystalline Se (at 20°C) were 3.1 and 7.0, respectively, for pure Se; they fell to minimum values of 1.4 and 3.3 at 0.065 wt.% Br, but rose again to 2.4 and 6.0 at 0.5 wt.% Br. Measurements of the electrical conductivity, σ, of the specimens showed that σ had a maximum at nearly the same Br content as κ had a minimum. To explain these results it is postulated that, with increasing Br content, Br at first occupies interstitial sites which form effective phonon-scattering centres and reduce κ; when the limit of interstitial solubility is reached, vacant lattice sites and defects are filled, and phonon-scattering centres are removed causing κ to increase again.

K.F.Hulme

536.212.2 : 537.322

2275. THERMAL CONDUCTIVITY AND THERMOELECTRIC PHENOMENA IN METALS IN A MAGNETIC FIELD.
M.Ya.Azbel', M.I.Kaganov and I.M.Lifshits.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1188-92 (1957). In Russian.

Asymptotic expressions for the tensors of the thermal conductivity and Thomson coefficients in a strong magnetic field were found. No special assumptions regarding the dispersion law or the collision integral were made in the deduction. A.

536.253 : 532.5 : 523.4

CONVECTION IN ROTATING FLUIDS. See Abstr. 2102

536.413.2

2276. COEFFICIENT OF EXPANSION OF POLONIUM.
R.E.Brocklehurst, J.M.Goode and L.F.Vassamillet.
J. chem. Phys., Vol. 27, No. 4, 985 (Oct., 1957).

A previously reported high negative value for the coefficient of linear expansion of αPo, namely -300×10^{-6}, was thought to be unlikely and a redetermination was made by X-ray diffraction methods. Two techniques were used, one involving temperature control between −195 and +24°C, the other employing Au as an internal standard. The mean value obtained was $23 \times 10^{-6} \pm \pm 1.5 \times 10^{-6}$. J.Thewlis

536.423.1 : 539.16

VARIATION OF THE ISOTOPIC COMPOSITION OF MERCURY ON EVAPORATION. See Abstr. 1999

536.424.1 : 537.226.2

EFFECT OF ELECTRIC FIELD ON PHASE TRANSITIONS OF $BaTiO_3$. See Abstr. 1674

536.48

2277. EXCITATION OF ROTONS IN HELIUM II BY COLD NEUTRONS. H.Palevsky, K.Otnes, K.E.Larsson, R.Pauli and R.Stedman.
Phys. Rev., Vol. 108, No. 5, 1346-7 (Dec. 1, 1957).

Inelastic scattering of cold neutrons by liquid helium I and II was investigated at a scattering angle of 90°. The sharp discontinuity in the transmissions of polycrystalline Be or BeO defined the incident energy. The scattered energy was measured with a slow chopper. The excitation by neutrons of rotons in He II was demonstrated. Two rotons were excited: one with wave-number 2.14 ± 0.07 A^{-1}, energy 10.7 ± 0.5 deg K and mean free path $\geq 2 \times 10^{-6}$ cm; and one with wave-number 1.8 ± 0.06 A^{-1}, energy 10.0 ± 0.7 deg K. The experiment confirms predictions by Cohen and Feynman (Abstr. 7827/1957). H.London

536.48

2278. PROPERTIES OF LIQUID He^3 AT LOW TEMPERATURE.
K.A.Brueckner and J.L.Gammel.
Phys. Rev., Vol. 109, No. 4, 1040-6 (Feb. 15, 1958).

The properties of liquid He^3 were determined at low temperature, by using a procedure applied to the study of nuclear matter (see Abstr. 2515-16/1958). The interactions considered are the de Boer and Yntema–Schneider potentials. The values predicted for the equilibrium density, energy, compressibility, specific heat, magnetic susceptibility (and its density variation) are in semiquantitative agreement with experiment. A.

536.48

2279. THEORY OF DIFFUSION AND THERMAL CONDUCTIVITY OF DILUTE He^3 SOLUTIONS IN HELIUM II.
I.M.Khalatnikov and V.N.Zharkov.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1108-25 (1957). In Russian.

The diffusion and thermal conductivity of dilute He^3 solutions in helium II are examined on the basis of Landau's theory of superfluidity of helium II. A solution of a set of kinetic equations was found for elementary excitations in the presence of temperature and concentration gradients in the solution. The temperature dependence of the effective thermal conductivity of the solution has been determined. A comparison with experiment is given. A.

536.48

2280. BROWNIAN MOTION OF A MIRROR IN SUPERFLUID HELIUM. N.L Balazs.
Phys. Rev., Vol. 109, No. 2, 232-4 (Jan. 15, 1958).

This paper treats the Brownian motion of a mirror suspended in a phonon or photon gas. It is shown that the properties of the medium, such as the statistics and the temperature dependence of the excitation concentration, influence the mean square Fourier amplitudes of the motion of the mirror. A.

536.48

2281. ROTATION OF LIQUID HELIUM AT LOW REYNOLDS NUMBERS. R.J.Donnelly.
Phys. Rev., Vol. 109, No. 5, 1461-3 (March 1, 1958).

Previous experiments on the transient and steady-state behaviour of the free surface of helium II in a bucket suddenly set into rotation showed that the normal and superfluid components are in common motion. This contradicts the simple two-fluid equations (neglecting mutual friction) and has been attributed to the fluid having exceeded some "critical velocity". The principle of dynamical similarity suggests that such experiments should be scaled according to the Reynolds number, and analysis of previous experiments indicates that this parameter has always been rather high ($> 3.7 \times 10^6$). The Reynolds number has been reduced to $\sim 1.4 \times 10^3$ by reducing the radius of the container to 0.0255 cm. The experimental results show that under these conditions the two fluids are still in common motion. The shape of the free surface was much different than in wider containers due to the effects of surface tension, which limit further reduction of the Reynolds number in this manner. A.

536.48

2282. FOCUSING OF THERMAL [SOUND] WAVES IN SUPERFLUID HELIUM. J.Fajans.
Phys. Rev., Vol. 108, No. 5, 1343-4 (Dec. 1, 1957).

Small carbon elements serving as thermal source and receiver were placed at conjugate points with respect to a spherical fused quartz surface (50 mm rad). Longitudinal traverse by the source and receiver showed up sharp focusing of 6 kc/s thermal waves in a helium bath at 1.8°K. H.London

536.51

2283. ON A THERMOMETER WITH RECOVERY FACTOR $r > 1$. J.A.Rietdijk and A.Valstar.
Appl. sci. Res. A, Vol. 7, No. 4, 251-5 (1958).

It is shown that it is possible to raise the recovery factor r [$r = (T_m - T)/(T_0 - T)$, where T_m = temperature indicated by the instrument, T = free-stream static temperature and T_0 = free-stream stagnation temperature] of a temperature-sensitive instrument (thermometer), located in a high-speed gas flow, above unity. Tests with such an instrument (thermocouple) in jets of air with both sub- and supersonic velocities are described. A design of the instrument is given. A.

536.521 : 537.312.5 : 535.33.07

APPLICATION OF PHOTOELECTRIC CELLS TO ABSOLUTE SPECTROMETRY AND PYROMETRY. See Abstr. 2225

536.62 : 536.33.08

2284. HIGH RADIATION-FLUX, ABSOLUTE, WATER-FLOW CALORIMETER. P.E.Glaser.
Rev. sci. Instrum., Vol. 28, No. 12, 1084-6 (Dec., 1957).

A high radiation-flux, measuring calorimeter was designed for use in imaging furnaces. It consists of a black-body receiver provided with a cooled aperture and cylindrical housing. It can be exposed to flux densities of the order of 400 cal/cm^2.sec for extended periods without deterioration. Thermopiles measure the temperatures of the inlet and outlet cooling water. The calorimeter is an absolute measuring device with a response time of one minute. The design virtually eliminates heat losses and permits the measurement of a wide range of heat fluxes. The probable error in the radiation-flux measurement is ±5%. A.

536.621

2285. LIQUID TIN SOLUTION CALORIMETER FOR MEASURING HEATS OF FORMATION OF ALLOYS.
R.L.Orr, A.Goldberg and R.Hultgren.
Rev. sci. Instrum., Vol. 28, No. 10, 767-73 (Oct., 1957).

A liquid tin solution calorimeter was constructed for determining the heats of formation of alloy phases from the heats of solution of the alloys and of the pure component metals in liquid tin. The design of the calorimeter is given, and the experimental procedures and calculation methods are described and illustrated with data from representative runs. These indicate that heats of formation of alloy phases may be determined with an average uncertainty of about ±50 cal/g-atom. A.

536.631 : 539.18

2286. HYPERFINE COUPLING SPECIFIC HEAT IN COBALT METAL. C.V.Heer and R.A.Erickson.
Phys. Rev., Vol. 108, No. 3, 896-8 (Nov. 1, 1957).

The specific heat of metallic cobalt was studied in the range 0.6 to 3.0°K. The contribution to it by the term proportional to T^{-2} is attributed to h.f.s. coupling, A/k being 0.0175 deg K. This is comparable in magnitude with that for cobalt in salts, and this suggests that the predominant h.f.s. interaction in the metal is with the 3d electrons. M.A.Grace

THERMODYNAMICS

536.7

2287. ON THE THERMODYNAMIC RELATIONS OF IRREVERSIBLE TRANSFORMATIONS AND THE CONDITIONS FOR THEIR VALIDITY. R.Gibert.
C.R. Acad. Sci. (Paris), Vol. 245, No. 19, 1602-4 (Nov. 4, 1957).
In French.

Another attempt to "derive" the Onsager relations by a macroscopic argument. Let the entropy S of an isolated system depend (thermostatically) on coordinates x_i so that $dS/dt = \Sigma_i (\partial S/\partial x_i)\, \dot{x}_i$. Assume now, as the "dynamic" law, that this entropy production is a positive differentiable function of velocities. This imposes on the system $dS/dt = \Sigma_i (\partial \Phi/\partial \dot{x}_i)\, \dot{x}_i$ where Φ is an appropriate dissipation function. The author "deduces" from this that $\partial S/\partial x_i = \partial \Phi/\partial \dot{x}_i$, a result equivalent to Onsager reciprocity. For argument around this idea see Abstr. 7645/1953, 7074/1956, 8916/1957. R.O.Davies

536.7

2288. ON THE QUESTION OF THE UNIQUENESS OF THE SOLUTION TO THE ONE-DIMENSIONAL STEFAN'S PROBLEM IN THE CASE OF A ONE-PHASE INITIAL STATE OF A HEAT-CONDUCTING MEDIUM. L.I.Rubinshtein.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 3, 387-90 (1957). In Russian.

A detailed proof, employing repeated use of the "principle of the maximum of sub-parabolic functions", is given of the uniqueness of the solution of the problem mentioned in the title, for various boundary conditions. M.J.Kearsley

536.7 : 532.7

2289. ON THE LINEAR PHENOMENOLOGICAL EQUATIONS. R.J.Bearman.
J. chem. Phys., Vol. 28, No. 4, 662-4 (April, 1958).

The transport processes of diffusion and heat flow in a nonreacting, nonelectrolyte fluid system are discussed in terms of the linear phenomenological equations without benefit of the Onsager reciprocal relations. The independent variables which determine the flow pattern, the operational significance of the phenomenological coefficients, and the inversion of the phenomenological equations are each considered. A.

ELECTRICITY

ELECTROSTATICS. DIELECTRICS

537.221 : 539.2

2290. TRIBOELECTRICITY AND ELECTRON TRAPS IN INSULATING MATERIALS: SOME CORRELATIONS.
E.Fukada and J.F.Fowler.
Nature (London), Vol. 181, 693-4 (March 8, 1958).

Ten different insulating materials have been tested for the polarity of electrification when rubbed against each other, and a sequence of increasing tendency towards negativity was established. A comparison with certain features of the electron trap distribution, as derived from measurements of X-ray-induced conductivity, indicates some correlation between these two properties of the materials. K.W.Plessner

537.226 : 621.315.61

2291. DIGEST OF THE LITERATURE ON DIELECTRICS.
Volume XX—1956. Edited by J.D.Hoffman and J.Hart.
Washington: National Academy of Sciences—National Research Council Publication 562 (1957) 237 pp.

This annual volume is prepared by the Committee on Digest of Literature of the Conference on Electrical Insulation. Instrumentation and measurements, R.A.Soderman (1-29) 232 refs. Tables of dielectric constants, dipole moments and dielectric relaxation times, A.J.Petro and D.A.Pitt (30-54) 129 refs. Molecular and ionic interactions in dielectrics, J.Hart and A.G.Mungall (55-88) 277 refs. Conduction phenomena in dielectrics, J.A.Rider (89-104) 111 refs. The breakdown of dielectrics, J.J.Chapman and L.J.Frisco (105-22) 125 refs. Ferroelectric and piezoelectric materials, A.D.Franklin and K.A.King (123-47) 233 refs. Ferromagnetic materials, J.B.Goodenough and D.O.Smith (148-89) 291 refs. Rubber and plastic insulation, S.Palinchak and C.W.Hamilton (190-210) 137 refs. Insulating films, H.A.Birdsall (211-21) 47 refs. Insulating liquids and their applications, J.E.Gibbons (222-33) 51 refs. Ceramic insulation, E.J.Smoke and S.Di Vita (234-7) 37 refs.

537.226.1 : 539.2

QUANTUM THEORY OF DIELECTRIC CONSTANT FOR SOLIDS. See Abstr. 2026

537.226.2

2292. DIELECTRIC ANISOTROPY OF PAPER AT 3400 Mc/s. THE INFLUENCE OF HUMIDITY.
R.Servant and J.Cazayus-Claverie.
C.R. Acad. Sci. (Paris), Vol. 245, No. 5, 509-11 (July 29, 1957).
In French.

Rectilinear birefringence and dichroism, observed at 3400 Mc/s, as in previous tests at 10 000 Mc/s (Abstr. 6592/1956) is shown to be due to moisture absorbed by the paper. J.H.Mason

537.226.2

2293. AN INVESTIGATION OF THE DIELECTRIC RELAXATION EXHIBITED BY GLASS. I. THEORY AND METHODS OF MEASUREMENT. H.E.Taylor.
J. Soc. Glass Technol., Vol. 41, 350T-382T (Dec., 1957).

Theory indicates that glass should exhibit dielectric relaxation phenomena when subjected to low-frequency a.c. fields, due to the mechanism responsible for the d.c. anomalous currents. Previous work which has a bearing on this has been briefly reviewed, and it was concluded that further measurements over a wide range of frequencies and temperatures were required. The theory involved and

the expected form of the a.c. phenomena are briefly described. Measurements have been made on three simple soda-lime–silica glasses, and on specimens of commercial sheet glass and Pyrex heat-resisting borosilicate glass, in order to determine whether or not glass shows dispersion of its dielectric constant and a peak of dielectric loss of the predicted form. The methods used to determine the dielectric constant and the dielectric loss at frequencies from 100 c/s to 20 kc/s throughout the range from room temperature up to about 400°C are described, a commercial model Schering bridge and a bridge constructed for the purpose of making measurements at high power-factor values being used. The dielectric properties were also measured at room temperature over a range of frequencies from 10 kc/s to 100 Mc/s on a commercial dielectric test set. Finally, determinations of d.c. conductivity were made on the same specimens, over the same temperature range as covered by the low-frequency measurements. The glasses were shown to exhibit dielectric relaxation phenomena of the expected form. The magnitude of the dispersion constant and a value for the energy of activation involved in the process were assessed. The latter was closely similar to the activation energy of the d.c. conduction, suggesting that the movement of the alkali ions was responsible for both phenomena. The form of the dielectric constant and the dielectric loss curves indicated that a wide distribution of relaxation times was involved. A.

ELECTRIC CONDUCTION. CURRENTS

537.311.1

2294. THE BOLTZMANN EQUATION IN THE THEORY OF ELECTRICAL CONDUCTION IN METALS. D.A.Greenwood.
Proc. Phys. Soc., Vol. 71, Pt 4, 585-96 (April, 1958).

The motion of conduction electrons in a metal in an electric field, scattered by an irregular static potential, is considered; this model is applicable to the resistance due to lattice waves at high temperatures, and to imperfections at any temperature. The Boltzmann equation is re-derived without the customary perturbation theory, avoiding the usual necessity of averaging over phases of different electron states after repeated small time intervals. The assumption that the scattering centres are distributed at random in the crystal is alone sufficient. The theory is, however, still dependent on assuming that $\hbar/\tau \ll kT$, where τ is the collision time, as is the usual perturbation theory, The author gives a general formula for the conductivity of the model, not subject to any assumption. This helps to justify an argument by Landau according to which the usual theory is valid provided $\hbar/\tau \ll \eta$, where η is the cut-off energy of the Fermi distribution. No direct evaluation of the formula has been achieved. A.

537.311.31

2295. A STUDY OF THE RESISTIVITY OF THE γ_2 PHASE OF Cu–Al ALLOYS. O.Pečijare and S.Janssen.
C.R. Acad. Sci. (Paris), Vol. 245, No. 15, 1228-30 (Oct. 7, 1957). In French.

Alloys containing between 16 and 20% Al were studied in the temperature range 0-800°C. In general the resistivity ρ varied with temperature in accordance with the law $\rho = \rho_0 \exp(\alpha T)$ in two separate temperature ranges on either side of 380°C. C.A.Hogarth

537.311.31 : 539.21

2296. DENSITY AND RESISTIVITY CHANGES IN Au–Cd UPON QUENCHING. W.J.Sturm and M.S.Wechsler.
J. appl. Phys., Vol. 28, No. 12, 1509-10 (Dec., 1957).

The previously reported large increases in resistivity of Au–Cd alloys with 49 atomic % Cd after quenching from 200-500°C was supposed to be due to the freezing-in of lattice vacancies formed at the higher temperature. This suggests, and experiment confirms, a change in density after quenching from a moderately high temperature. C.A.Hogarth

537.311.31

2297. ELECTRICAL RESISTIVITY OF SEPARATED LITHIUM ISOTOPES. D.D.Snyder and D.J.Montgomery.
Phys. Rev., Vol. 109, No. 1, 222-3 (Jan. 1, 1958).

Reports measurements on Li^6 and Li^7 from room temperature to 77° K. The residual resistances at 4.2° K were measured and the ideal resistances deduced. The Bloch–Grüneisen relation gives qualitative agreement with the experimental temperature dependence of the ratio of the ideal resistances for the two isotopes. D.M.Edwards

537.311.31

2298. THE RESISTIVITY OF ORDERED Au_3Cu.
P.Wright and K.F.Goddard.
Proc. Phys. Soc., Vol. 71, Pt 3, 506-8 (March, 1958).

This was measured at 20°C after quenching the specimens from annealing temperatures in the range 100° to 700°C. The resistivity passed through a sharp maximum at an annealing temperature of 190°C; also, below 190°, a slow decrease in resistivity with annealing time was observed. The results suggest that ordering takes place below 190°C and the increased resistance is attributed to electron scattering by small nuclei of nearest-neighbour order. Explanations for a secondary resistivity maximum observed near 500°C are considered. K.W.Plessner

537.311.31 : 539.219

2299. ON SOME PECULIARITIES OF THE TEMPERATURE DEPENDENCE OF THE ELECTRICAL CONDUCTIVITY OF THE SYSTEMS OF CONTINUOUS ATOMIC SOLUTIONS SILVER–GOLD, INDIUM–LEAD AND BISMUTH–ANTIMONY IN THE SOLID AND LIQUID STATES. F.Gaĭbullaev and A.R.Regel'.
Zh. tekh. Fiz., Vol. 27, No. 10, 2240-5 (1957). In Russian.

The conductivities, σ, were measured by the rotating magnetic field method. The results are presented as graphs of σ against composition at various temperatures (20-1200°C). For all the systems, at low temperature σ had a minimum at intermediate composition, but at high temperature the minimum disappeared and σ was a linear function of composition. For Ag–Au alloys σ decreased on melting by a factor of 1.8-2 depending on composition; for In–Pb the factor was 1.1-1.9. For Bi–Sb σ increased by a factor of 1.3-2.4 on melting. The results are discussed and compared with those for other systems. K.F.Hulme

537.311.33

2300. EVAPORATION OF IMPURITIES FROM SEMICONDUCTORS. K.Lehovec, K.Schoeni and R.Zuleeg.
J. appl. Phys., Vol. 28, No. 4, 420-3 (April, 1957).

Equations are derived for the impurity distribution that arises by evaporation of impurities from the surface of a homogeneously doped semiconductor. The rate of evaporation is assumed to be proportional to the surface concentration. When a rectifying metal contact is made to a semiconductor with such an impurity distribution, the dependence of capacitance on the applied voltage can be used to determine the proportionality constant between rate of evaporation and surface concentration. Experimental data are presented for the evaporation of Sb from Sb-doped Ge. A.

537.311.33 : 621.382

2301. ON CARRIER ACCUMULATION, AND THE PROPERTIES OF CERTAIN SEMICONDUCTOR JUNCTIONS. J.B.Gunn.
J. Electronics and Control, Vol. 4, No. 1, 17-50 (Jan., 1958).

The phenomenon of accumulation first described by Low (see Abstr. 5406/1955) takes place when minority carriers in a semiconductor flow across an l–h junction from the lightly-doped (l) side to the heavily-doped (h) side. The behaviour of l–h junctions is analysed mathematically starting from five basic equations which provide relationships between the hole and electron currents and their corresponding density and potential gradients, continuity equations for the currents, and Poisson's equation written for the space charge of holes, electrons, and ionized impurities. In the analysis the concepts of transport velocity, defined as the ratio of the minority carrier current density at a point to the excess minority carrier density there over its thermal equilibrium value, and leakage velocity which measures the departure from semi-permeable behaviour of l–h junctions, are introduced. The analyses together with various approximate solutions are applied to explain certain properties of filamentary junction, and formed point-contact transistors, the control of recombination velocity at semiconductor surfaces, and to the current in p–i–n diodes. The determination of the leakage velocity of an l–h junction is described. C.A.Hogarth

537.311.33

2302. HIGH-FREQUENCY RELAXATION PROCESSES IN THE FIELD-EFFECT EXPERIMENT. C.G.B.Garrett.
Phys. Rev., Vol. 107, No. 2, 478-87 (July 15, 1957).

A theoretical treatment is given of two dispersion phenomena in the field-effect experiment: (1) dispersion arising from the finite time required to generate minority carriers, and (2) relaxation of the fast surface states. It is shown that the in-phase part of the field-effect mobility is given (for an n-type semiconductor) by $\mu_{FE} = -\mu_n + A/(1+\omega^2\tau_1^2) - B/(1+\omega^2\tau_2^2)$, where $(\omega/2\pi)$ is the frequency of the applied field, A and B are constants, and τ_1 and τ_2 are characteristic times, all four quantities being functions of the body resistivity,

surface potential, and of the densities, energy levels, and capture cross-sections of the fast states. Under certain conditions, τ_1 is equal to the fundamental decay-mode lifetime of the sample, while τ_2 is expected to be much shorter, and depends primarily on the cross-sections and the position of the state level in the gap. A comparison of the theory with recent experimental results of Montgomery shows (1) that reasonable agreement can be obtained, and (2) that the presence of any significant number of states in the region close to the centre of the gap is unlikely. A.

537.311.33

2303. VARIATION OF MOBILITY WITH ELECTRIC FIELD IN NONDEGENERATE SEMICONDUCTORS. M.S.Sodha.
Phys. Rev., Vol. 107, No. 5, 1266-71 (Sept. 1, 1957).

In a recent communication Sclar (Abstr. 3257/1957) has discussed the nature of ionized-impurity scattering when the product of the carrier wave number and the distance at which the scattering potential is cut off is much less than unity. Sclar studied the mobility under these conditions, but neglected the influence of the lattice scattering and of the electric field. In the present communication, the variation of mobility with electric field is studied, taking lattice scattering into account. For semiconductors of low impurity concentration at usual temperatures, the product of the carrier wave number and the distance at which the scattering potential is cut off is much larger than unity. In this case Conwell (Abstr. 4079/1950) has given a theory for the variation of mobility with electric field, assuming a δ-function distribution for free electrons in a semiconductor. Her theory predicts a net zero-field mobility, which at first increases with decreasing impurity mobility. This conclusion is physically untenable and leads one to doubt the assumptions implied in the theory. The assumption of a δ-function distribution seems to be the least reliable. Hence the calculations are repeated by chooding a Maxwellian distribution of electron velocities, appropriate to a temperature, which in general is different from that of the phenon distribution. This leads to a net zero-field mobility monotonically decreasing with decreasing impurity mobility which is reasonable enough. Other interesting results at variance with Conwell's treatment have also been obtained. A.

537.311.33

2304. THEORY OF INTERSTITIAL IMPURITY STATES IN SEMICONDUCTORS. P.E.Kaus.
Phys. Rev., Vol. 109, No. 6, 1944-52 (March 15, 1958).

The ionization energy and expectation value of the radius corresponding to the states of several interstitial impurities in Ge and Si are calculated. The range of the valence electron of the impurity is divided into two regions; an inner region, which is treated microscopically, and an outer region, which is treated macroscopically. At a critical separation radius a rapid change of ionization energy and wavefunction results. The calculations are carried out for several impurities in column I of the periodic table. A.

537.311.33

2305. ON THE THEORY OF SURFACE RECOMBINATION IN SEMICONDUCTORS FOR LARGE POTENTIAL DIFFERENCES BETWEEN SURFACE AND BULK. F.Berz.
Proc. Phys. Soc., Vol. 71, Pt 2, 275-80 (Feb., 1958).

It is shown that the Boltzmann distribution law for free electrons and holes breaks down (a) when the carriers which recombine at the surface form an appreciable proportion of the injected carriers which fall on the surface during the same time interval and (b) when over part of the surface space-charge layer the potential variation over a mean free path is $\sim kT/e$ or greater. The second case is analysed mathematically. C.A.Hogarth

537.311.33 : 538.63

2306. A SOURCE OF ERROR IN MAGNETORESISTANCE MEASUREMENTS. R.F.Broom.
Proc. Phys. Soc., Vol. 71, Pt 3, 500-2 (March, 1958).

Experiments with specimens of GaAs and InSb in which the specimen is rotated in a magnetic field and measurements are made at various orientations show a regular variation in value of magnetoresistance, due to a partial reduction of the internal Hall field from a shorting effect of the potential contacts when the crystal is in some orientations. C.A.Hogarth

537.311.33 : 538.63

2307. INFLUENCE OF THE ORBITAL QUANTIZATION IN A MAGNETIC FIELD ON THE LONGITUDINAL RESISTANCE-VARIATION OF COVALENT SEMICONDUCTORS. II. J.Appel.
Z. Naturforsch., Vol. 11a, No. 11, 892-901 (Nov., 1956). In German.

For Pt I, see Z. Naturforsch., Vol. 11a, No. 9, 689 (1956). The Boltzmann equation for isotropic, non-degenerate semiconductors is set up on the assumption of elastic electron collisions with acoustic lattice vibrations. An approximate solution is derived which leads to the following values of the longitudinal magnetoresistance effect $\Delta\rho/\rho$ (ρ = resistance in zero field, $\Delta\rho$ = resistance variation) for constant carrier density. If $\gamma = (m/m^*)\mu H/kT$, (m = free electron mass, m* effective electron mass, μ = Bohr magneton, H = magnetic field, k = Boltzmann's constant, T = absolute temperature) then $\Delta\rho/\rho \approx \gamma^2/12$ when $\gamma \ll 1$, $\Delta\rho/\rho \approx 0.7\gamma - 1$ when $\gamma > \sim 3$ and numerical values are given for $\gamma = 1,2$. The application to measurements is discussed. R.Stratton

537.311.33 : 538.632

2308. CONCERNING THE SATURATION OF THE HALL "CONSTANT" IN SEMICONDUCTORS LOCATED IN STRONG MAGNETIC FIELDS. F.G.Bass and M.I.Kaganov.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1233-5 (1957). In Russian.

An expression for the Hall "constant" in strong magnetic fields is obtained which is valid for semiconductors with narrow bands. A.

537.311.33 : 539.2

2309. ON THE EXCITON MECHANISM OF CAPTURE OF CURRENT CARRIERS IN HOMOPOLAR SEMICONDUCTORS. V.L.Bonch-Bruevich.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1470-8 (1957). In Russian.

Capture of charge carriers by structural defects involving transfer of energy to small-radius excitons is investigated. The temperature dependence of the recombination coefficients is determined. A.

537.311.33

2310. THEORY OF SEMICONDUCTORS WITH EXCITED IMPURITY BAND. M.I.Klinger and Yu.I.Zozulya.
Zh. tekh. Fiz., Vol. 27, No. 10, 2285-90 (1957). In Russian.

The electrical properties of a semiconductor with a majority impurity level and excited impurity band are discussed. It is shown that the majority electrical characteristics behave as in the case of the presence of a majority impurity band. This may serve as one of the explanations of the experimental result that anomalies assumed to be due to impurity bands are observed at low concentrations.

537.311.33 : 538.63 : 538.27

2311. RESISTIVITY AND MAGNETORESISTANCE OF Au_2Mn. J.H.Smith and R.Street.
Proc. Phys. Soc. B, Vol. 70, Pt 11, 1089-92 (Nov., 1957).

This material has the property that a characteristic threshold field, depending on temperature, must be exceeded before ferromagnetism is developed (Abstr. 2409/1957). Measurements are reported at fields up to 2.1×10^4 oersted and between 20° and 500°K. The temperature variation of resistance is like that of nickel. Below the Néel point (360°K) the magnetoresistance is anisotropic; its variation with temperature is similar to that of the magnetocaloric effect. The results are discussed on a band model. E.P.Wohlfarth

537.311.33 : 537.323

2312. THE ELECTRICAL CONDUCTIVITY AND THERMOELECTRIC POWER OF BISMUTH TELLURIDE. H.J.Goldsmid.
Proc. Phys. Soc., Vol. 71, Pt 4, 633-46 (April, 1958).

The electrical conductivity and thermoelectric power of the semiconductor Bi_2Te_3 have been measured between 150°K and 300°K. Both n-type and p-type samples with a wide range of carrier concentration have been included. Most samples have shown extrinsic conduction and have been partially degenerate over at least part of the temperature range, so it has been necessary to use Fermi–Dirac statistics in interpreting the results. A few samples have exhibited mixed and intrinsic conduction at the higher temperatures. It has been possible to determine the variation of carrier mobility with temperature and to estimate the energy dependence of the relaxation time, as well as a number of the semiconductor parameters. A.

537.311.33

2313. ELECTRICAL RESISTIVITY OF BORON.
E.S.Greiner and J.A.Gutowski.
J. appl. Phys., Vol. 28, No. 11, 1364-5 (Nov., 1957).

The electrical conductivity of polycrystalline boron, prepared by decomposing BCl_3 on a hot W or Ta filament, was measured as a function of temperature from −160 to 700°C. Intrinsic conduction was observed about 300°C, the room temperature resistivity was about 10^6 ohm.cm, and the gap width was estimated as 1.39 ± 0.05 eV C.A.Hogarth

537.311.33 : 535.37 : 535.345

DISCUSSION OF SOME ELECTRICAL PROPERTIES OF Cu_2O.
See Abstr. 2245

537.311.33

2314. NEW PHENOMENON IN NARROW GERMANIUM P–N JUNCTIONS. L.Esaki.
Phys. Rev., Vol. 109, No. 2, 603-4 (Jan. 15, 1958).

Above 0.03 V in the forward direction the current decreases with increasing voltage and then above about 0.15 V increases again, but with a higher resistance than shown in the reverse direction. The general behaviour is practically independent of temperature. The junction width is ~ 150 A and the built-in field is 5×10^5 V.cm^{-1}. An energy-band diagram for the junction is proposed and analysis enables the form of characteristic to be predicted theoretically.
C.A.Hogarth

537.311.33

2315. ON ELECTRON SCATTERING BY THE OPTICAL MODES IN INDIUM ANTIMONIDE. M.Rodot.
C.R. Acad. Sci. (Paris), Vol. 245, No. 13, 1051-4 (Sept. 23, 1057). In French.

The magnetothermoelectric and Nernst effects in p-type InSb with $N = 1.4 \times 10^{17}$ cm^{-3} are reported as functions of temperature and magnetic field. The results indicate polar scattering of electrons and agree qualitatively with a theory of Kane. Results on very pure n- and p-type specimens provide evidence of ambipolar diffusion.
C.A.Hogarth

537.311.33

2316. HALL EFFECT AND MAGNETORESISTANCE OF THIN FILMS OF INDIUM ANTIMONIDE. J.Launay.
C.R. Acad. Sci. (Paris), Vol. 245, No. 14, 1122-4 (Sept. 30, 1957). In French.

Reports measurements on stable layers with reproducible properties, of thickness from 300 A to 2500 A, and with applied magnetic fields up to 35 000 oersted. The Hall effect is about 400 times greater than obtained with bismuth, but the magnetoresistance is smaller.
C.A.Hogarth

537.311.33

2317. THEORETICAL RESULTS CONCERNING THIN FILMS OF INDIUM ANTIMONIDE. A.Colombani and J.Launay.
C.R. Acad. Sci. (Paris), Vol. 245, No. 19, 1607-8 (Nov. 4, 1957). In French.

The electronic conductivity decreases as the film thickness decreases until the thickness becomes comparable with the mean free path, thus giving an estimate of 580 A. Analysis of Hall effect and resistivity data gives an independent value of 660 A.
C.A.Hogarth

537.311.33 : 621.315.59

2318. AVALANCHE MULTIPLICATION AND ELECTRON MOBILITY IN INDIUM ANTIMONIDE AT HIGH ELECTRIC FIELDS. A.C.Prior.
J. Electronics and Control, Vol. 4, No. 2, 165-9 (Feb., 1958).

The current–voltage characteristic of indium antimonide was measured up to a field of 800 V/cm. Avalanche multiplication was found to occur at fields above 150 V/cm. No variation of electron mobility was found up to the highest fields used.
A.

537.311.33 : 537.312.9

2319. PIEZORESISTANCE OF INDIUM ANTIMONIDE. R.F.Potter.
Phys. Rev., Vol. 108, No. 3, 652-8 (Nov. 1, 1957).

By applying a tensile stress to specially prepared and oriented samples, the piezoresistivity coefficients of both n- and p-type InSb were measured over the temperature range 77° to 300°K. The results for extrinsic p-type material are similar to those for p-type Si and Ge, indicating that the valence band structure is similar. Extrinsic n-type InSb results confirm the picture of a conduction band having its minimum at the centre of the Brillouin zone. The largest effect that was observed in intrinsic material was in the volume coefficient, and can be attributed to the change in the forbidden gap due to dilatation of the lattice. The value of this change of gap per unit strain was estimated to be $E_{1g} = -7.0$ eV.
A.

537.311.33

2320. PIEZORESISTANCE CONSTANTS OF P-TYPE InSb. A.J.Tuzzolino.
Phys. Rev., Vol. 109, No. 6, 1980-7 (March 15, 1958).

The change of resistance in uniaxial tension was measured for several single-crystal specimens of p-type InSb over the range 77° K to 350° K. The difference between the donor and acceptor concentrations for these specimens ranges from 3×10^{15} cm^{-3} to 7×10^{17} cm^{-3}. The piezoresistance coefficients were found to depend on impurity concentration. The elasto-Hall constant was measured at 77° K for the purest specimens and the experimental results indicate that, in the extrinsic range, the large piezoresistance is primarily due to stress induced changes in the tensor mobility of the holes. The shear coefficients were found to vary approximately linearly with T^{-1} in the extrinsic range. It is concluded that the valence band extrema occur at, or very near, K = 0 in the Brillouin zone with energy surfaces similar to those of Si and Ge.
A.

537.311.33

2321. PROPERTIES OF p-TYPE INDIUM ANTIMONIDE. I. ELECTRICAL PROPERTIES. C.Hilsum and R.Barrie.
Proc. Phys. Soc., Vol. 71, Pt 4, 676-85 (April, 1958).

The dependence of electron and hole mobilities on carrier concentration has been determined for p-type indium antimonide with impurity concentrations ranging from 10^{14} to 2×10^{17} cm^{-3}. The method used was the analysis of the variation of Hall coefficient and resistivity with a magnetic field. Good agreement was obtained with a simple theory, which assumed that the carrier relaxation time is independent of energy. The decrease of electron mobility with acceptor concentration can be explained by assuming that in pure indium antimonide the important scattering mechanisms are polar scattering and electron–hole scattering.
A.

537.311.33

2322. LIFETIMES OF EXCESS CARRIERS IN InSb. P.T.Landsberg.
Proc. Phys. Soc. B, Vol. 70, Pt 12, 1175-6 (Dec., 1957).

It is pointed out that the ratio of bulk to radiative lifetimes in InSb may be estimated by two distinct methods: from the optical absorption coefficient and from recombination radiation. The latter estimate appears to be too large by a factor of order two, and it is suggested that this may be due to a quantum efficiency in excess of unity in the recombination radiation experiment.
P.T.Landsberg

537.311.33

2323. SEMICONDUCTING PROPERTIES OF Mg_2Si SINGLE CRYSTALS. R.G.Morris, R.D.Redin and G.C.Danielson.
Phys. Rev., Vol. 109, No. 6, 1909-15 (March 15, 1958).

High-purity n-type single crystals of the semiconducting compound Mg_2Si were prepared from melts of stoichiometric proportions of the constituents in graphite crucibles; p-type crystals were obtained when the melt was doped with silver or copper. Carrier concentration in the saturation region were as low as 8×10^{16} cm^{-3} for n-type and 4×10^{17} cm^{-3} for p-type samples. Electrical resistivity ρ and Hall coefficient R were measured from 77° K to 1000° K. Hall mobility R/ρ showed a temperature dependence in the intrinsic range of approximately $T^{-5/2}$ for all samples. At 300° K, R/ρ was as high as 406 cm^2.volt^{-1}.sec^{-1} for p-type material. The ratio of electron mobility to hole mobility was approximately five. The energy gap, determined from the least-square slopes at high temperature of the curves $\log(RT^{3/2})$ v. $1/T$, was 0.78 eV. The electron mobility at any temperature in the range 77° to 400° K can be explained quantitatively by a combination of scattering by optical modes and scattering by ionized impurities.
A.

537.311.33

2324. SEMICONDUCTING PROPERTIES OF Mg_2Ge SINGLE CRYSTALS. R.D.Redin, R.G.Morris and G.C.Danielson.
Phys. Rev., Vol. 109, No. 6, 1916-20 (March 15, 1958).

Single crystals of Mg_2Ge have been obtained from melts of the constituents, and Hall effect and electrical resistivity measurements have been made from 77° K to 1000° K. Undoped crystals were n-type and had saturated impurity carrier concentration as low as 3×10^{15} cm^{-3}; silver-doped crystals were p-type and had saturated impurity carrier concentrations roughly proportional to the amount of added silver. The room-temperature Hall mobilities were observed to be 280 cm^2.volt^{-1}.sec^{-1} for electrons and 110 cm^2.volt^{-1}.sec^{-1} for holes. The hole mobility observed in the extrinsic region (120° K to 350° K) of the highest purity p-type sample and the mobility difference observed in the intrinsic region (350° K to 700° K) of the n-type samples varied with temperature as $T^{-2.0}$. The mobility difference was found to decrease faster than $T^{2.0}$ above 700° K. The width of the energy gap at absolute zero, as determined from the temperature dependence of both the resistivity and the Hall effect in the intrinsic region, was 0.69 ± 0.01 eV.
A.

537.311.33

2325. ELECTRON EMISSION FROM AVALANCHE BREAKDOWN IN SILICON. J.A.Burton.
Phys. Rev., Vol. 108, No. 5, 1342-3 (Dec. 1, 1957).

Caesium was diffused into the surface region of a silicon rod containing a p–n junction. After application of a reverse-biassed voltage across the junction, electron emission due to avalanche generation in the junction was detected. The Cs acted to reduce the silicon work-function. C.A.Hogarth

537.311.33 : 535.343

2326. INFRARED ABSORPTION OF OXYGEN IN SILICON. H.J.Hrostowski and R.H.Kaiser.
Phys. Rev., Vol. 107, No. 4, 966-72 (Aug. 15, 1957).

Three i.r. absorption bands were correlated with the oxygen concentration of Si. Spectra taken between 4.2° and 297°K show an unusual temperature-dependent fine structure in the most intense band at 1106 cm^{-1}. Isotopic shifts of two bands were observed at low temperatures in samples enriched with O^{18}. These results can be explained by a model in which interstitial oxygen is bonded to two adjacent Si atoms in a nonlinear Si–O–Si unit. Observations on samples with a different history indicate a direct, but complicated, dependence of some growth-dependent variables on oxygen concentration. A.

537.311.33 : 538.632

2327. GALVANOMAGNETIC EFFECTS IN p-TYPE SILICON. D.Long.
Phys. Rev., Vol. 107, No. 3, 672-7 (Aug. 1, 1957).

Measurements were made on several samples of p-type Si of the dependences of electrical resistivity and Hall effect on temperature and magnetic field strength. The electrical resistivity follows a $T^{2.7}$ law in the lattice scattering range in the absence of a magnetic field. The Hall coefficient exhibits a small linear negative temperature dependence between about 200° and 320°K, and is almost entirely independent of field strength up to 13 000 G at any temperature between 77° and 320°K. The dependence of the magnetoresistance on the relative directions of current, field and crystallographic axes has been studied at 77° and 300°K as a function of the field strength, with particular emphasis on obtaining accurate values of the various coefficients that are required for a complete characterization of the magnetoresistance in the limit of zero field. The main features of these results are the relatively large observed values of longitudinal magnetoresistance, which in some cases are nearly as large as the transverse effects. The results of the galvanomagnetic measurements are somewhat inconsistent with the usual valence band model as deduced from cyclotron resonance experiments at 4°K. A.

537.311.33 : 539.2

2328. ON THE STRUCTURE OF ELECTRON SPECTRA OF TELLURIUM-TYPE LATTICES. Yu.A.Firsov.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1350-67 (1957). In Russian.

The general properties of the energy spectrum of an excess electron in a tellurium-type crystal lattice were investigated by group-theory methods without using the weak or strong coupling approximations. The possibility of contiguity of the bands in certain directions in the k-space is demonstrated. The influence of spin–orbit interaction is studied. It is shown that semiconductors of this type may contain two types of carriers of the same sign. Dispersion relations in the approximation which is quadratic with respect to k are obtained under various assumptions regarding the position of the extrema for E(k). A.

537.311.33 : 621.382

2329. CARRIER MOBILITIES AT LOW INJECTION LEVELS. J.A.Hoerni.
Proc. Inst. Radio Engrs, Vol. 46, No. 2, 502 (Feb., 1958).

The expressions derived by Sah et al. (see Abstr. 178/1958) for the diffusion currents flowing across a p–n junction, taking into consideration the existence of an electric field outside the transition layer, were obtained on the assumption that the space charge due to the divergence of this field is negligible. It is shown that this approximation is not justified. R.C.Glass

537.311.33 : 621.382

2330. EDGE BREAKDOWN OF P–N JUNCTIONS IN GERMANIUM. B.M.Vul and A.P.Shotov.
Zh. tekh. Fiz., Vol. 27, No. 10, 2189-94 (1957). In Russian.

The breakdown voltages of diffusion and alloyed p^+n^- and n^+p^- junctions in germanium were measured in air and in media of high dielectric strength. It was found that the dielectric strength of the medium appreciably affects the breakdown voltage of n^+p^- junctions, but plays an insignificant part in the breakdown of p^+n^- and diffusion junctions. The observed phenomena may be explained as being due to the presence on the surface of the germanium of a positive charge, which alters the thickness of the junction close to the surface, the medium determining the effectiveness of the surface charge.

537.312.5 : 537.312.8

2331. ON THE ANISOTROPY OF THE EVEN (TRANSVERSE) PHOTOMAGNETIC EFFECT IN GERMANIUM MONOCRYSTALS. I.K.Kikoin and Yu.A.Bȳkovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 116, No. 3, 381-4 (1957). In Russian.

The even photomagnetic (photomagnetoelectric) effect (so termed because there is no change of sign on reversal of magnetic field) in a (111) plane showed marked variations on rotation about the [111] axis suggesting three-fold symmetry, while [110] rotation of a (110) cut specimen suggested two-fold symmetry. No explanation of this behaviour is possible in terms of the simple theory of the effect (see Abstr. 1283/1957). C.H.L.Goodman

537.312.5

2332. HIGH-VOLTAGE PHOTOVOLTAIC EFFECT. L.Pensak.
Phys. Rev., Vol. 109, No. 2, 601 (Jan. 15, 1958).

Values of the photovoltaic e.m.f. of 100 V/cm were obtained by illuminating the surface of thin evaporated films of cadmium telluride. The effect is markedly dependent on the angle of incidence of the evaporated material on the substrate and is zero for normal incidence. The substrate temperature must be between 100° and 250°C during deposition. The film is formed of crystallites of size about that of the film thickness ($\approx 1\,\mu$). G.F.J.Garlick

537.312.5

2333. PROPERTIES OF PHOTOVOLTAIC FILMS OF CdTe. B.Goldstein.
Phys. Rev., Vol. 109, No. 2, 601-3 (Jan. 15, 1958).

The properties of CdTe in thin film form (preceding abstract) are discussed. The photovoltaic effect cuts off at wavelengths greater than that of the absorption edge (8300 A) and shows a marked rise with decrease in temperature. The large photovoltages observed are ascribed to additive effects from a large number of junctions or barriers in series and the estimate of 10^4 per cm agrees with the crystallite size in the films. There is a large degree of crystallographic ordering in the film which is assumed to be responsible for the additive effect of the photovoltages.

G.F.J.Garlick

537.312.5

2334. PHOTOELECTRIC EFFECTS IN InAs AT ROOM TEMPERATURE. C.Hilsum.
Proc. Phys. Soc. B, Vol. 70, Pt 10, 1011-13 (Oct., 1957).

Photoconductive, photovoltaic and photoelectromagnetic effects were observed, and photocells constructed with response out to 4 microns and a sensitivity of 10^{-9} watts. C.Hilsum

537.312.5 : 536.521 : 535.33.07

APPLICATION OF PHOTOELECTRIC CELLS TO ABSOLUTE SPECTROMETRY AND PYROMETRY. See Abstr. 2225

537.312.62

2335. ON A NEW METHOD IN THE THEORY OF SUPERCONDUCTIVITY. N.N.Bogoljubov.
Nuovo Cimento, Vol. 7, No. 6, 794-805 (March 16, 1958).

A generalization of the method elaborated by the author for the theory of superconductivity is presented. It is shown that the original Frȕhlich model possesses the property of superconductivity. The ground state and its fermion excitations are considered. A.

537.312.62

2336. COMMENTS ON THE THEORY OF SUPERCONDUCTIVITY. J.G.Valatin.
Nuovo Cimento, Vol. 7, No. 6, 843-57 (March 16, 1957).

Some ideas of the new theory of Bardeen, Cooper and Schrieffer (Abstr. 1708/1958) are expressed in a more transparent form. New collective fermion variables are introduced which are linear combinations of creation and annihilation operators of electrons, and describe elementary excitations. They lead to a simple classification of excited states and a great simplification in the calculations. The structure of the excitation spectrum is investigated without equating the matrix element of the interaction potential to a constant at an early stage, and new relationships and equations are derived. The temperature dependent problem is described by means of a statistical operator, and its relationship to that of the grand canonical ensemble is established. Simple new relationships are obtained for the correlation function. A.

537.312.62 : 538.22

2337. ON THE MAGNETIC PROPERTIES OF SUPERCONDUCTORS OF THE SECOND TYPE. A.A.Abrikosov.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1442-52 (1957). In Russian.

A study is made of the magnetic properties of the second type (massive) superconductors for which the parameter κ of the Ginsburg–Landau theory is greater than $1/\sqrt{2}$. The results explain some of the experimental data on the behaviour of superconducting alloys in a magnetic field. A.

537.312.8

2338. NEW TYPE OF OSCILLATORY MAGNETORESISTANCE IN METALS. J.Babiskin and P.G.Siebenmann.
Phys. Rev., Vol. 107, No. 5, 1249-54 (Sept. 1, 1957).

The magnetoresistive properties of a thin Na wire were studied at 1°K in transverse magnetic fields (H_T) up to 60 000 G. This study was undertaken in order to determine whether magnetoresistive oscillations of the de-Haas–van Alphen type could be detected in the vicinity of 60 000 G. Although no such oscillations were found, the magnetoresistance for H_T below 15 000 G exhibited a completely new type of oscillatory phenomena. These new oscillations are periodic in H with a decreasing amplitude in increasing magnetic fields, whereas the de Haas–van Alphen oscillations would be periodic in H^{-1} with an increasing amplitude in increasing magnetic fields. The period of these new oscillations is in excellent agreement with the period of the oscillatory behaviour predicted theoretically by Sondheimer for the magnetoresistance due to surface scattering of thin metallic films in H_T. From this period, a value for the electronic momentum was obtained. The significance of these new oscillations is discussed. A.

537.312.8

2339. ON GALVANOMAGNETIC PROPERTIES OF FERROMAGNETICS NEAR THE ABSOLUTE ZERO OF TEMPERATURE. K.P.Belov and A.V.Ped'ko.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 815-17 (1958). In Russian.

Magnetoresistance measurements on Ni, and on Ni–Fe, Cu–Ni and Mn–Ni alloys, at low temperatures are reported.

537.321 : 548

2340. THERMOELECTRIC POWER OF IONIC CONDUCTING CRYSTALS. R.E.Howard and A.B.Lidiard.
Phil. Mag. (Eighth Ser.), Vol. 2, 1462-7 (Dec., 1957).

The thermoelectric power, Θ, of crystals which conduct electricity by movement of Frenkel or Schottky defects is analysed in terms of the concentration of defects, their mobility and their heat of transport. Particular attention is given to AgCl and AgBr containing divalent impurity ions, and isothermals showing the dependence of Θ on foreign ion concentration c are constructed. The power increases (algebraically) in proportion to c at small concentrations, reaches a maximum and then slowly decreases with further addition of impurity: the overall changes in Θ are ~ 1 mV/deg.C.
A.B.Lidiard

537.322 : 536.212.2

THERMOELECTRIC PHENOMENA IN METALS IN A MAGNETIC FIELD. See Abstr. 2275

537.39 : 539.18

EFFECT OF D.C. CURRENT ON THE ISOTOPIC COMPOSITION OF MERCURY. See Abstr. 2000

ELECTRIC DISCHARGES

537.52 : 533.7

2341. THE NATURE AND PROPERTIES OF ELECTRON "GASES". M.Bayet.
Onde élect., Vol. 37, 1111-15 (Dec., 1957). In French.

The distribution function of electrons in a plasma invariably approximates to a Maxwellian form corresponding to a temperature well in excess of that of the gas itself. Theoretical treatment based on the model of a Lorentz gas, even when carried out rigorously, predicts a distribution function differing both from the Maxwell and the Druyvesteyn form. In this model electron–electron collisions are neglected. When these are taken into account it is shown that the electrons rapidly assume a Maxwellian distribution at the observed high temperature and it is only much more slowly that they have any effect on the temperature of the ions and neutral molecules of the gas. G.D.Sims

537.521 : 621.387

2342. SPACE CHARGE, FIELD EMISSION AND THE IONIC CONDENSER. A REPORT. H.Ritow.
J. Electronics and Control, Vol. 4, No. 2, 97-110 (Feb., 1958).

A century of experimental data, research and theory uncovered some of the fundamental processes involved in discharge of electricity through gases but has failed so far to provide satisfactory explanations for many phenomena. The measurement of the charge densities on the electrodes just prior to the start of each flash of intermittent glow in hydrogen revealed the presence of a high electrostatic field at the smaller of a pair of electrodes at the moment of flash initiation. When the small electrode was the cathode this field was approximately equal to the emission field of the cathode metal. It was concluded that this field provided the trigger mechanism to start the flash. When the small electrode was the anode the measurements again indicated a high field before each flash. This was interpreted to be the emission field of the ionized gas. The hypothesis of the emission field as the criterion for the start of a spark or flash was checked against a number of published experimental researches. The studies so made confirmed the hypothesis and resulted in modifications of the theory and in simple explanations for such phenomena as those of wire-cylinder discharge, discharges at high pressures, Wilson's lag experiments, the exceptions to the Paschen law and others. The explanation offered for the high field is that concentrated space charges form ionic condensers with the electrodes and/or produce within the gas ionic condensers in the form of stationary striations, i.e. of two space-charge layers of opposite sign. The total charge on each electrode is the sum of the charge due to the external field plus the charge induced by the space-charge. A.

537.521 : 621.387

2343. THE FIELD EFFECT OF SPACE-CHARGE IN THE INTERMITTENT GLOW IN HYDROGEN. H.Ritow.
J. Electronics and Control, Vol. 4, No. 2, 111-24 (Feb., 1958).

Gill, Mitra and Clark found that the effective tube capacity during intermittent glow discharge was several orders larger than could be accounted for by the geometry of the tube and electrodes. A method is developed for measuring the charge on the electrodes at the moment of flash initiation. This charge is shown experimentally to be approximately 10^{-7} coulombs for each cm^2 of the smaller of the two electrodes. This means that the electrostatic field at this electrode is of the order of 10^6 V/cm. Since the emission field of the electrode metal is of the same order, the possibility exists that field emission plays a role in initiating a flash along with photo-ionization and exponential avalanche formation. A.

537.523.3

2344. ELECTRICAL DISCHARGES BETWEEN COAXIAL ELECTRODES. J.S.T.Looms.
Nature (London), Vol. 181, 696-7 (March 8, 1958).

Describes the appearance of positive and negative wire impulse corona for a wire–coaxial ring geometry, using transients lasting about a microsecond. Spark-over voltages are also given for coaxial cylinders. Both series of observations indicate the shielding effect of the corona formed in negative wire conditions.
J.D.Craggs

537.523.4

2345. LONGITUDINAL GRADIENTS IN THE CHANNEL OF A LONG SPARK. I.S.Stekolnikov.
Izv. Akad. Nauk, SSSR, Otdel. tekh. Nauk, 1957, No. 5, 133-6. In Russian.

A new method determining the gradients is presented, since previous results are contradictory. It is based on a relation between the voltage established when the leaders from opposite sides meet and the lengths of their respective channels and branches. These data may be determined from synchronized oscillograms of the voltage across the gap, and from leader photographs obtained by a special electro-optical shutter at the instant of meeting of the leaders. Electrical Research Association

537.525 : 523.03

2346. OBSERVATIONS OF EXPLOSIONS OF HIGH-SPEED PLASMA IN A MAGNETIC FIELD. W.H.Bostick.
Astrophys. J., Vol. 127, No. 1, 237 (Jan., 1958).

Photographic explosion studies of plasma, two-dimensionally isotropic with respect to a magnetic field applied perpendicular to the plane of isotropy, reveal significant differences in the resultant plasmoid pattern depending on whether the process occurs in a non-conducting, or conducting medium. If the conduction is initiated by photoionization of a residual gas (at 2 μ pressure) the time-exposure pattern somewhat resembles the Crab Nebula photographed in H_α light. D.R.Barber

537.525 : 539.17

2347. PINCHED DISCHARGE AND THERMONUCLEAR REACTORS. J.W.Gardner.
Nuovo Cimento, Vol. 6, No. 5, 1228-9 (Nov., 1957).

One of the difficulties which beset the exploitation of the pinched discharge in thermonuclear reactors is the "kinking" instability. The present note suggests a perturbation theory approach for the theoretical analysis of this instability. J.W.Gardner

537.525

2348. CONDUCTIVITY OF PLASMAS TO MICROWAVES. H.Margenau.
Phys. Rev., Vol. 109, No. 1, 6-9 (Jan. 1, 1958).

A relation between the current-induced part of the distribution function (f_1) and the isotropic part (f_0), which was previously derived with limiting restrictions, is here shown to be valid at moderate electric fields for any form of f_0, e.g., for the case where an agency other than the passing microwaves determines it. The complex conductivity is then computed for a variety of functions f_0 (δ-function, step function, Maxwellian distribution) and for different assumptions as to the dependence of the collision frequency on electron speed. The integrals encountered in this work are shown to be computable with good accuracy by means of a saddle-point procedure which is described. A.

537.525.8

2349. QUENCHING OF THE NEGATIVE GLOW BY MICROWAVES IN COLD-CATHODE GASEOUS DISCHARGES. J.M.Anderson.
Phys. Rev., Vol. 108, No. 3, 898-9 (Nov. 1, 1957).

Describes the effect of microwave absorption in a discharge, i.e. the temporary reduction of recombination radiation due to an increase in electron temperature caused by the absorption. Experimental data are given and discussed for a 10.2 mm Hg helium discharge. J.D.Craggs

X-RAYS

537.531

2350. ON SEVERAL REGULARITIES IN THE STRUCTURE OF THE X-RAY EMISSION K-SPECTRUM OF TITANIUM IN TITANATES. É.E.Vaĭnshteĭn, M.N.Bril' and I.B.Starÿĭ.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 4, 597-600 (1957). In Russian.

A previous investigation (Vaĭnshteĭn, Starÿĭ and Bril', Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, 784, 1956) suggested that the satellite Kβ'' of titanium compounds arose from cross transitions to the K-level of the metal. The present paper reports further work on the measurement of the Kβ'' and $K\beta_2$ lines in various titanates. Regularities in relative intensity of these lines are observed in certain titanates, leading to information on the electronic structure. T.Mulvey

537.531 : 537.525

2351. X-RADIATION FROM A POWERFUL PULSE DISCHARGE IN XENON. I.M.Podgornÿĭ and S.A.Chuvatin.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 5, 795-7 (1957). In Russian.

At the start of a discharge, X-radiation occurs due to the action of charged particles. At a later time further X-radiation is observed whose photon energy is greater than that corresponding to the applied potential difference between electrodes. This radiation is the subject of the present investigation, and is associated with discontinuities in the electric current/time characteristic of the discharge. A double oscillograph was used to display both X-radiation and the pulse current as a function of time. By using xenon and hydrogen it is shown that the inertia of the gas is the controlling factor for this delayed radiation. T.Mulvey

537.531 : 535.34

2352. SOFT X-RAY ABSORPTION BY THIN FILMS OF VANADIUM. B.K.Agarwal and M.P.Givens.
Phys. Rev., Vol. 108, No. 3, 658-9 (Nov. 1, 1957).

The absorption was measured in the spectral region between 190 and 250 A. The observed absorption band is interpreted as a combination of M_3 and M_4 bands in the ratio of 2 : 1, and separated by 1.5 eV. The results are compared with previous determinations on Cr and Fe. A.

537.531 : 535.331

2353. K X-RAY SPECTRUM OF Hg. O.Beckman.
Phys. Rev., Vol. 109, No. 5, 1590 (March 1, 1958).

Wavelength values are given for 9 lines in the K X-ray spectrum of mercury as measured with a bent-crystal spectrometer. The high luminosity made it possible to use only 15 watts loading of the X-ray tube, thus preventing too rapid evaporation of mercury from the silver-amalgam anticathode. A.

CATHODE RAYS. POSITIVE RAYS

537.533

2354. DEPENDENCE OF THE BREMSSTRAHLUNG INTENSITY FROM A BETATRON ON THE BASIC INJECTION PARAMETERS. V.N.Logunov, E.P.Ovchinnikov and V.D.Rusanov.
Zh. tekh. Fiz., Vol. 27, No. 5, 1135-42 (1957). In Russian.

Detailed experimental measurements lead to the conclusion that no single mechanism accounts for the capture of injected electrons into betatron oscillations. A slowly rising and quickly falling injection pulse is recommended to achieve best performance from a betatron. W.O.Lock

537.533.75 : 539.23

2355. ENERGY SPECTRUM OF AN ELECTRON BEAM HAVING TRAVERSED A THIN METALLIC FILM. C.Fert and F.Pradal.
C.R. Acad. Sci. (Paris), Vol. 246, No. 2, 252-5 (Jan. 13, 1958). In French.

The energy spectrum of a beam of electrons after passing through a thin metal film was measured using a magnetic velocity spectrometer. The primary beam energy could be varied from 20 to 45 keV. Al, Cr, Bi, Au, Ag and Cu films were used. The results are in agreement with those of previous investigators. A.E.I. Research Laboratory

537.533.79 : 539.12

2356. AN EXPERIMENT FOR POLARIZATION OF FREE ELECTRONS. S.Yamaguchi.
Nuovo Cimento, Vol. 6, No. 4, 977-8 (Oct., 1957).

An electron beam is observed to split after passage through a ferromagnetic substance. It is suggested that the splitting is due to polarization of the electrons in accordance with the theory of van der Spuy (Abstr. 2312/1957). J.W.Sturgess

537.533.92 : 537.572

2357. ENERGY OF IONIZATION BY ELECTRONS IN SILICON CRYSTALS. V.M.Patskevich, V.S.Vavilov and L.S.Smirnov.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 804-5 (1957). In Russian.

An extension of earlier work on germanium (Abstr. 8690/1957), to silicon, using 10-30 keV electrons. The mean ionization energy for Si was found to be 4.2 ± 0.6 eV. W.O.Lock

537.534

2358. METHOD FOR DAMPING PHASE OSCILLATIONS IN A SYNCHROTRON. E.J.Rogers.
Rev. sci. Instrum., Vol. 29, No. 3, 215-17 (March, 1958).

A phase oscillation damping system was developed and successfully tested at the Brookhaven Cosmotron. Phase differences between the induced voltage in the beam pickup plates and the r.f. accelerating voltage are detected and fed back to the frequency control system. The frequency of the r.f. accelerating voltage is thus adjusted to provide a phase restoring force. The usual 50% beam loss during the accelerating cycle is eliminated and tests indicate that the beam stability with respect to disturbances in field v. frequency characteristic is improved by a factor of five. A.

537.534

2359. ON THE USE OF THE EINSTEIN–FOKKER EQUATION FOR THE DETERMINATION OF THE LOSS OF PARTICLES IN THE RESIDUAL GAS IN ACCELERATORS. B.M.Bolotovskiĭ and A.P.Fateev.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 304-6 (1957). In Russian.

Discussion of theory, together with results for the cases of 250 MeV electron synchrotron and 10 BeV proton synchrotron. W.O.Lock

537.534.3

2360. SECOND-ORDER ABERRATIONS IN A MODIFIED MATTAUCH-TYPE MASS SPECTROMETER. C.F.Robinson.
Rev. sci. Instrum., Vol. 28, No. 10, 777-9 (Oct., 1957).

Control of the energy-dependent second-order aberrations in a

Mattauch-type mass spectrometer is made difficult by the absence of a real image between the object slit and the focal plane in this resolving system. By curving the boundary of the magnetic field and by choosing appropriate relations between the magnetic field boundary curvature and the other parameters involved, it is possible to make both of the energy-dependent second-order aberration coefficients vanish simultaneously while retaining the advantages peculiar to this resolving system. A.

537.534.3

2361. SPACE CHARGE NEUTRALIZATION IN THE IONIZING BEAM OF A MASS SPECTROMETER. R.H.Plumlee.
Rev. sci. Instrum., Vol. 28, No. 10, 830-2 (Oct., 1957).

A mass spectrometer ion source structure and its mode of operation are described by which the resolved ion current produced from a given gas concentration in the ionizing chamber can be made one to two orders of magnitude larger than is usually obtained in conventional mass spectrometer ion sources. This structure employs an ionizing chamber whose walls are electrically insulated from each other so they can operate at separate potentials which permit positive ions to be trapped in the ionizing electron beam. The resulting partial neutralization of the electronic space-charge allows the use of a higher current density ionizing beam and also increases the effective ionizing volume from which a stable ion current can be extracted. Inherently this mode of operation produces more fragmentation species because it increases the probability of several successive electron impacts on each particle. A.

537.534.8

2362. KINETIC EJECTION OF ELECTRONS FROM TUNGSTEN BY CESIUM IONS. P.M.Waters.
Phys. Rev., Vol. 109. No. 5, 1466-7 (March 1, 1958).

Measurements of γ_i (number of electrons per incident ion) for caesium ions on atomically clean tungsten surfaces are reported. Vacuum conditions were such that subsequent to heating the tungsten to 2400°K a monolayer of gas was formed on the surface in ~ 4 hours. Since measurements were taken within 30 seconds after heating the tungsten to this temperature, the surface contamination is $< 0.3\%$ of a monolayer. The striking feature of these data is that the yields are smaller than previously reported. It was noted during the experiment that the yield increased if background gases were allowed to accumulate on the tungsten surface. A.

DISCHARGE TUBES.

IONIZATION. THERMIONICS

537.542

2363. A CONTRIBUTION TO THE STUDY OF HIGH FREQUENCY ION SOURCE. E.Skurnik.
Comment. phys. math. (Helsinki), Vol. 19, Paper 4, 53 pp. (1957).

The testing of an h.f. ion source of high proton yield and low gas and power consumption, designed for use in connection with a Van de Graaff generator, is fully described. The observed interrelation of ion and discharge currents, probe voltage, pressure, and plasma density are presented in graphical form. Plasma focusing and the effect of static magnetic fields on the discharge are studied.
A.E.I. Research Laboratory

537.562

2364. CROSS-SECTIONS OF ELECTROSTATIC INTERACTION IN PLASMAS. DEFINITIONS. M.Bayet.
C.R. Acad. Sci. (Paris), Vol. 245, No. 20, 1708-10 (Nov. 13, 1957). In French.

These determine the rate at which the anisotropic and a-Maxwellian deviations from equilibrium relax. The definitions follow from the assumption that the distribution function, given by a Boltzmann equation for binary collisions, can be expanded in terms of the independent components of the respective deviations.
P.Gray

537.562

2365. CROSS-SECTIONS OF ELECTROSTATIC INTERACTIONS IN PLASMAS. CALCULATION. M.Bayet.
C.R. Acad. Sci. (Paris), Vol. 245, No. 26, 2493-6 (Dec. 23, 1957). In French.

See preceding abstract. These are calculated for central forces using the Debye potential function. A table of values for the anisotropy cross-section, showing dependance on temperature and concentration, is given. A relation between this and the energy cross-section is derived by an approximate method, leading to a qualitative argument which indicates that the Maxwellian distributions of ions and electrons may correspond to very different temperatures.
P.Gray

537.562

2366. MEASUREMENTS OF IONIZATION CROSS SECTIONS FOR ELECTRON IMPACT. I. TECHNIQUE AND DATA FOR METHANE. B.A.Tozer.
J. Electronics and Control, Vol. 4, No. 2, 149-59 (Feb., 1958).

Some of the difficulties encountered in adapting a Lozier-type ionization chamber for cross-section measurements are described, and methods indicated by which they may be overcome. In particular, the errors arising from elastic scattering of electrons and the subsequent increase in effective electron path length, and from the different collection efficiencies for positive and negative ions, are dealt with. Finally some positive ion cross-section measurements in methane are described. A.

537.562

2367. THE MOBILITIES OF IONS IN THEIR PARENT GASES. A.Dalgarno.
Phil. Trans. A, Vol. 250, No. 982, 426-39 (1958).

The available experimental data on the mobilities at low field strengths of ions in their parent gases are analysed on the basis of a simple theoretical description. It is shown that the maxima observed in recent measurements of charge-transfer cross-sections are difficult to reconcile with measured mobilities of atomic ions in atomic gases, and that it is not necessary to invoke charge transfer to explain the observed mobilities of diatomic and polyatomic molecular ions in atomic gases; however, charge transfer is probably operative in cases of diatomic ions in diatomic gases. Finally, a semi-empirical method is used to predict the mobilities over a wide range of temperature and the charge-transfer cross-sections over a wide range of impact energies of the ions of atomic hydrogen and deuterium, the inert gases, mercury and atomic oxygen, and an estimate is given of the mobility of N_2^+ ions in N_2. A.

537.562

2368. ENERGY EXCHANGE BETWEEN ELECTRON AND ION GASES THROUGH COULOMB COLLISIONS IN PLASMAS. A.A.Dougal and L.Goldstein.
Phys. Rev., Vol. 109, No. 3, 615-24 (Feb. 1, 1958).

The general aspects of energy exchange among the electron, ion, and molecule constituent gases, and their energy transfer to the boundary, are examined for a partially ionized gas. Coulomb collisions between electrons and ions are identified to contribute significantly to thermal energy transfer from the electron gas, even in very weakly ionized gases. Experiments were performed to determine the time required for electron temperature deviations from equilibrium to return to equilibrium with the ion and molecule temperature. The method of guided microwave interaction within the plasma was employed for selectively heating the electron gas to increments above that of the ion and gas temperatures, and for sensing the subsequent electron temperature deviations through the electrical conductivity of the plasma. In addition, phototube detection of the plasma luminous intensity is employed to detect electron temperature deviations. The experimental results show that energy exchange between electron and ion gases is predominant in the experimental plasmas, under appropriate conditions, where the ionization is less than 0.001%. In a plasma produced in neon gas at 2.25 mm Hg, 300°K, the characteristic time for equipartition of excess mean electron energy with the ion gas varies from 11 to 5 μsec as the ion concentration increases from 1.6 to 5.8×10^{11} per cm^3. These times are much shorter than the 160 μsec which would be required for the electron temperature to return to equilibrium in the absence of Coulomb collisions. The expected behaviour with respect to ion concentration and ion mass is confirmed, but an anomaly with respect to electron temperature is found. A.

537.562 : 536.23

2369. ELECTRON–ELECTRON INTERACTION AND HEAT CONDUCTION IN GASEOUS PLASMAS. L.Goldstein and T.Sekiguchi.
Phys. Rev., Vol. 109, No. 3, 625-30 (Feb. 1, 1958).

The phenomenon of heat conduction in gaseous plasmas was observed in order to explore the problem of the mutual electron interaction. In addition to the technique of interaction of pulsed microwaves in decaying plasmas, the phenomenon of "afterglow quenching" was exploited in the experiments. The experimental values of the thermal conductivity, in low-gas-pressure neon and

xenon plasmas of adequately high charge density, were determined by two different methods. They were found to be of the order of 10^{-8}-10^{-5} (joules/cm.sec.deg) for the electron density range 10^{11}-10^{13} (cm^{-3}) at room temperature (~ 300°K). The most significant result of these experiments is that the thermal conductivity in the plasmas described is chiefly determined by heat flow in the electron gas of the plasma. Thus the mutual interaction of the electrons plays a predominant role in the phenomenon of heat conduction. The experimentally obtained values of the thermal conductivity are in agreement within less than one order of magnitude with those given by the theory of Spitzer and Härm. A.

537.562

2370. A NOTE ON THE CROSS SECTION FOR ELECTRON ATTACHMENT IN AIR. E.Kuffel.
Proc. Phys. Soc., Vol. 71, Pt 3, 516-17 (March, 1958).

Describes new results obtained with an electron filter (Bradbury type) apparatus. The data agree approximately with the results of Harrison and Geballe, using a Townsend ionization-chamber apparatus, but represent a considerable departure from Bradbury's original results. J.D.Craggs

537.562 : 530.162

2371. A STATISTICAL THEORY OF SYSTEMS OF CHARGED PARTICLES TAKING INTO ACCOUNT SHORT-RANGE REPULSION FORCES. I.P.Bazarov.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1163-70 (1957). In Russian.

The free energy of an electrically neutral system of charged particles (ions) was found by explicitly taking into account the repulsive forces between the particles. The general expression for the free energy of such systems is used to compute this quantity for the particular case of "long-range" and "short-range" forces. A.

537.562 : 530.162

2372. ON THE THEORY OF TRANSFER PROCESSES IN A PLASMA LOCATED IN A MAGNETIC FIELD. E.S.Fradkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1176-87 (1957). In Russian.

Mean statistical characteristics (velocity and heat fluxes, etc.) which determine transfer phenomena in a plasma located in a magnetic field were found. A.

537.562 : 534.222.2

STRUCTURE OF A SHOCK WAVE IN A PLASMA.
See Abstr. 2196

537.564

2373. CORRELATION BETWEEN IONIZING [α] AND ATTACHMENT [η] COEFFICIENTS AND BREAKDOWN CHARACTERISTICS FOR CARBON TETRAFLUORIDE. P.R.Howard.
Nature (London), Vol. 181, 645-6 (March 1, 1958).

Reports measurements on ionization currents in carbon tetrafluoride. Results are given as graphs of $(\alpha - \eta)/p$ v. E/p (E is the electric field and p the gas pressure) and $\alpha/(\alpha - \eta)$ v. the percentage by which the value of E/p exceeds that for which $\alpha = \eta$. J.Dutton

COSMIC RAYS

537.591

2374. COUNTING RATE OF COSMIC RAY COUNTER TELESCOPES IN INCLINED DIRECTIONS.
D.A.Tidman and K.W.Ogilvie.
Nuovo Cimento, Vol. 6, No. 3, 735-8 (Sept., 1957).

A geometrical correction factor must be introduced into the expression for directional intensity measured with a counter telescope whose cross-sectional area is not small compared with its length. Formulae are deduced which allow the geometrical correction to be evaluated rapidly to sufficient accuracy for most experimental purposes. P.Rothwell

537.591

2375. A CORRECTION TO PREVIOUSLY QUOTED COSMIC RAY FLUX VALUES. C.J.Waddington.
Nuovo Cimento, Vol. 6, No. 3, 748-50 (Sept., 1957).

Systematic errors in flux values of multiply-charged nuclei in cosmic radiation arise when no allowance is made for the particles which enter the emulsion while it is rising to ceiling altitude. Numerical evaluations of the corrections which should be applied to α-particle fluxes on four different flights are given. It is pointed out that the correction amounts to as much as 18% reduction in α-flux at the top of the atmosphere over S.England, and corrections to fluxes of heavier nuclei for emulsions flown over N.Italy amount to ~ 11% at the top of the atmosphere. P.Rothwell

537.591

2376. FLUX OF SLOW μ-MESONS AND PROTONS NEAR THE GEOMAGNETIC EQUATOR. A.Subramanian, S.Naranan, P.V.Ramanamurthy, A.B.Sahiar and S.Lal.
Nuovo Cimento, Vol. 7, No. 1, 110-13 (Jan. 1, 1958).

The vertical fluxes of slow μ-mesons and slow protons in air, have been evaluated at Ootacamund, 7 500 feet above sea level and ~ 2° N geomagnetic latitude, using a multiplate cloud-chamber triggered by a Geiger counter telescope. These fluxes are given as $(3.7\text{-}4.4) \times 10^{-6}$, and $(0.9\text{-}1.1) \times 10^{-6}$ particles per g of air per sec per steradian for μ-mesons and protons respectively. The latitude effect for slow mesons between 2° N and 50° N is calculated to lie between 2.7 and 3.4, while the latitude effect for slow protons between 2° N and 50° N is calculated to be between 2.7 and 5.5. These values are compared with values for the latitude effect obtained by other workers. P.Rothwell

537.591.1

2377. THE SIMPLE CONES OF ALBEDO OF COSMIC RAYS.
R.Gall and J.Lifshitz.
Nuovo Cimento, Vol. 7, No. 5, 601-6 (March 1, 1958).

Simple albedo cones for five points of incidence were evaluated for different proton energies. The latitude, longitude and energy effects are discussed. Some results are compared with those of Schremp. The altitude, above which the interaction with the atmosphere does not invalidate the results, is given. The validity of the albedo model for different altitudes is discussed. The points of emission were studied. A.

537.591.15

2378. ON THE ANGULAR DISTRIBUTION OF SECONDARY PARTICLES OF HIGH ENERGY JET SHOWERS.
S.Hasegawa, J.Nishimura and Y.Nishimura.
Nuovo Cimento, Vol. 6, No. 4, 979-81 (Oct., 1957).

Explains a method of investigating high-energy nuclear interactions based on the assumption that the shower particles have a unique transverse momentum. K.H.Barker

537.591.15

2379. ENERGY DETERMINATION OF ELECTROMAGNETIC CASCADES IN NUCLEAR EMULSIONS. K.Pinkau.
Phil. Mag. (Eighth Ser.), Vol. 2, 1389-92 (Nov., 1957).

The procedure proposed is to measure the radial distribution of cascade electrons at a given distance from the origin. Measurements were made on five cascades with primary energies 130-1100 GeV to provide calibration graphs, and a comparison made with the theory of Nishimura and Kamata (Abstr. 8924/1952). E.J.Burge

537.591.15

2380. RARE HIGH-ENERGY PHOTON JET IN COSMIC RAYS.
O.B.Young and T.S.Yoon.
Phys. Rev., Vol. 108, No. 3, 908-9 (Nov. 1, 1957).

An event, consisting of seven electron pairs in an emulsion stack, is described. The energies of these pairs range from 126 to 3630 MeV, and total nearly 11 BeV. The photons do not materialize at the same distance from some common origin; there is no evidence that materialization depends upon energy. The axis zenith angle is 98°, indicating that the source is a nuclear interaction at lower altitude than the balloon. The photon jet is very narrow; the half-angle of the cone enclosing all particles is less than 0.001 radians. P.Rothwell

537.591.15

2381. THE SOFT COMPONENT OF AN ELECTRON—NUCLEAR SHOWER AT AN ENERGY OF THE ORDER OF 10^{14} eV.
I.M.Gramenitskiĭ, G.B.Zhdanov, M.I.Tret'yakova and M.N. Shcherbakova.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 282-3 (1957). In Russian.

The development of the electron—photon component of a shower initiated in a photographic emulsion by an α-particle of energy $8^{+3}_{-4} \times 10^{13}$ eV has been studied. The spatial and energy distributions of electron—positron pairs, and the spatial distribution of electrons are given. The photon concentration and the energy flux near the shower axis was found to be higher than expected on the basis of measurements of angular distribution and transverse momentum. S.Chomet

537.591.5

2382. LOGARITHMIC REPRESENTATION OF COSMIC-RAY INTENSITY. M.Wada.
J. Sci. Res. Inst. (Tokyo), Vol. 51, 201-10 (Dec., 1957).

To evaluate the quantities which indicate the variational amounts relative to the mean of cosmic-ray intensity, the use of their natural

logarithms is examined. While a standard unit is required for the relative intensity when represented by ordinary percentage value, it is not needed for the logarithmic indication. Several advantages due to the use of logarithms are described. A.

537.591.5

2383. DIRECT OBSERVATION OF PERIODIC VARIATION OF PRIMARY COSMIC-RAY INTENSITY.
M.A.Pomerantz, S.P.Agarwal and V.R.Potnis.
Phys. Rev., Vol. 109, No. 1, 224-5 (Jan. 1, 1958).

It is stated that a periodic variation in cosmic-ray intensity near the top of the atmosphere, has been measured with balloon-borne quadruple coincidence counter trains, during the maximum phase of the solar cycle, and that the flux sometimes decreases to as much as 25% below normal intensity, during this period. P.Rothwell

537.591.5

2384. COSMIC-RAY CHANGES FROM 1954 TO 1957.
H.V.Neher and H.Anderson.
Phys. Rev., Vol. 109, No. 2, 608 (Jan. 15, 1958).

It is deduced, from comparison of data obtained with ionization chambers flown in balloons, that the flux of cosmic-ray particles near the top of the atmosphere at Thule, Greenland decreased by a factor of 4, between August 1954, sunspot minimum, (0.24 particles $cm^{-2}.sec^{-1}.sterad^{-1}$) and August 1957, sunspot maximum (0.056 particles, $cm^{-2}.sec^{-1}.sterad^{-1}$). P.Rothwell

MAGNETISM

538.113

2385. MAGNETIC INTERACTION BETWEEN ELECTRONS AND ANOMALOUS DIAMAGNETISM. B.T.Geĭlikman.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1206-11 (1957). In Russian.

It is shown that magnetic interaction within the framework of perturbation theory of an ideal electron gas does not lead to the appearance of anomalous diamagnetism. A.

538.113

2386. SUPEREXCHANGE IN AMMONIUM CHLOROIRIDATE.
J.H.E.Griffiths, J.Owen, J.G.Park and M.F.Partridge.
Phys. Rev., Vol. 108, No. 5, 1345-6 (Dec. 1, 1957).

An investigation of paramagnetic resonance in crystal solid solutions of $(NH_4)_2IrCl_6$ in (diamagnetic) $(NH_4)_2PtCl_6$. In dilute solutions (Ir : Pt ≤ 1%) spin resonance from isolated $(IrCl_6)^{2-}$ complexes was obtained. For Ir : Pt ~10% appreciable numbers of nearest neighbour pairs of $(IrCl_6)^{2-}$ occur: antiferromagnetic exchange interactions between the corresponding pairs of unbalanced spins give rise to a triplet level and a singlet, the triplet having fine structure since the exchange interaction is slightly anisotropic. The coefficients of this exchange interaction were determined by studying resonance transitions between the components of the triplet. The singlet--triplet separation deduced from the intensity of these transitions is in agreement with that obtained from a molecular field interpretation of the high-temperature paramagnetic susceptibility of pure $(NH_4)_2IrCl_6$. A.B.Lidiard

538.114

2387. SUPEREXCHANGE INTERACTION.
J.Yamashita and J.Kondo.
Phys. Rev., Vol. 109, No. 3, 730-41 (Feb. 1, 1958).

Superexchange interaction in the MnO crystal is studied by using the Heitler–London picture including overlap. Mechanisms proposed by Slater, Kramers and Anderson, and Goodenough are developed on the same basis. The energy difference between the antiparallel spin state and the parallel spin state is computed numerically in the case of the simple four-electron problem. A.

538.114

2388. SUPEREXCHANGE INTERACTION ENERGY FOR Fe^{3+}-O^{2-}-Fe^{3+} LINKAGES. M.A.Gilleo.
Phys. Rev., Vol. 109, No. 3, 777-81 (Feb. 1, 1958).

The superexchange interaction energy for an Fe^{3+}–O^{2-}–Fe^{3+} linkage is considered for seven oxides in which Fe^{3+} is the only magnetic ion present, and for magnetite. The superexchange energy may be estimated from the value of T_C/n, where T_C is the Curie temperature and n is the number of Fe^{3+}–O^{2-}–Fe^{3+} interactions per Fe^{3+} ion per formula unit. The average value of T_C/n is 115° (range 106 to 132°). The only compounds considered are antiferromagnetic oxides in which Fe^{3+} ions are present in one set of crystallographically equivalent positions and ferrimagnetic oxides in which Fe^{3+} ions are present in two different sets of crystallographically equivalent positions. No distinct correlation of superexchange energy with Fe^{3+}–O^{2-} distances or with the included angle in the linkages is evident. Superexchange coupling is considered only for contact distances and for included angles substantially greater than 90°. A.

538.114

2389. LOSS OF EXCHANGE COUPLING IN THE SURFACE LAYERS OF FERROMAGNETIC PARTICLES. F.E.Luborsky.
Phys. Rev., Vol. 109, No. 1, 40-2 (Jan. 1, 1958).

Experiments with spherical iron particles 28 A to 265 A in diameter demonstrate that the proposed nonferromagnetic surface layer on an iron particle must be less than 1 A thick. This conclusion is based upon a comparison of the ferromagnetic iron indicated by magnetic saturation, and the total amount of iron as determined by chemical analysis. A.

538.114

2390. ANALOGY BETWEEN DIRECTIONAL ORDERING AND THE MAGNETIC DIFFUSION AFTEREFFECT. P.Brissonneau.
J. appl. Phys., Vol. 29, No. 3, 249-51 (March, 1958).

The preferential distribution of carbon atoms among three different interstitial sites of α iron, depending on the direction of the spontaneous magnetization, has a close formal resemblance to the directional order induced by a field cooling. The measurement of the hysteresis loops of α iron and with carbon content 0.0046% by weight actually revealed such close resemblance to those of the Perminvar type alloys and those of certain ferrites containing cobalt oxide. A.

538.114

2391. ANALYTICAL THEORY OF THE BEHAVIOUR OF FERROMAGNETIC MATERIALS. G.Biorci and D.Pescetti.
Nuovo Cimento, Vol. 7, No. 6, 829-42 (March 16, 1958).

It is shown that every transformation in the J–H plane of a ferromagnetic specimen can be computed from the magnetization curve and saturation loop of the material. This is based on the assumption that each volume element is characterized by a rectangular loop of sides a and b (Preisach model). Also, it must be assumed that a distribution function $\varphi(a,b)$, related to the probability density of finding a loop with given (a,b), exists and is unique. Then, given an arbitrary path of H, $\varphi(a,b)$ permits the computation of the corresponding path of J. The function $\varphi(a,b)$ can be computed numerically by manipulation of the magnetization curve and saturation loop. Experiments have been carried out on two materials, magnetically quite different. The theoretical curves fit the experimental data quite well. A.

538.114

2392. EFFECTIVE NUCLEAR SPIN INTERACTIONS IN FERROMAGNETS. H.Suhl.
Phys. Rev., Vol. 109, No. 2, 606 (Jan. 15, 1958).

Describes a new type of indirect nuclear spin–spin interaction which takes place through the hyperfine coupling of the nucleus to the electron spins of the same ion and the exchange interaction between electron spins on different ions. A formula is derived for the second moment and in the case of Mn^{++} gives a value for the line width of 0.14 Mc/s. It is considered that the difficulty of observing nuclear resonance in ferromagnetics may arise from this cause. D.J.Oliver

538.114

2393. TEMPERATURE DEPENDENCE OF FERROMAGNETIC ANISOTROPY. W.J.Carr, Jr.
Phys. Rev., Vol. 109, No. 6, 1971-6 (March 15, 1958).

The temperature dependence of the crystalline anisotropy constants of iron, cobalt, and nickel is discussed. It is shown that Zener's result for iron (i.e., the first anisotropy constant varies as the tenth power of the magnetization) also may be derived from molecular field theory. In cobalt a satisfactory agreement with experiment is obtained by using Zener's results together with the postulate that the intrinsic anisotropy varies with thermal expansion in the manner recently calculated by the author. For nickel the temperature dependence of K_1 seems to require, in addition to the tenth power of the magnetization, a multiplicative factor that is linear in the temperature. No explanation has been found for this latter term. A.

538.12

2394. NEW METHOD FOR MAKING MAGNETIC FIELDS VISIBLE. L.Suchow.
J. appl. Phys., Vol. 29, No. 2, 223-4 (Feb., 1958).

Thin, plate-like crystals of α-Fe_2O_3 align themselves in a magnetic field so that an axis in the plane of the broad face of the crystal is parallel to the field. If a liquid suspension of such crystals is subjected to a magnetic field, orientation of the assemblage occurs in such a manner that the field becomes visible by reason of the transparency of the suspension when the plates are parallel to the line of sight, the brightness when incident light is reflected, and the darkness in other orientations. A.E.De Barr

538.22

2395. MAGNETIC PROPERTIES OF DYSPROSIUM SINGLE CRYSTALS. D.R.Behrendt, S.Legvold and F.H.Spedding.
Phys. Rev., Vol. 109, No. 2, 1544-7 (March 1, 1958).

Single crystals of metallic dysprosium were grown by the Bridgman method and their magnetic properties determined in different crystallographic directions of the hexagonal close-packed structure. Below the Néel point of 178.5°K the individual magnetic moments are aligned perpendicular to the c_0 axis. The moments are aligned in an antiferromagnetic manner from 178.5°K down to 85°K and in a ferromagnetic manner below 85°K. Measurements with the field parallel and perpendicular to the c_0 axis reveal magnetic anisotropy at all temperatures. Below 110°K magnetic anisotropy is also observed in the basal plane. The direction of easy magnetization is along an a_0 axis. In the c_0 direction the crystals are extremely "hard" magnetically, the magnetization curves being linear as in the case of a paramagnetic material. The saturation moments follow the T^2 law. A.

538.22

2396. MAGNETIC PROPERTIES OF HOLMIUM AND THULIUM METALS. B.L.Rhodes, S.Legvold and F.H.Spedding.
Phys. Rev., Vol. 109, No. 5, 1547-50 (March 1, 1958).

The magnetic moments of holmium and thulium metals were measured in applied fields of 3000-18 000 oersted, over the temperature range of 4.2-300°K. Holmium, paramagnetic above 133°K, appears to be antiferromagnetic between 20°K and 133°K, and ferromagnetic below 20°K. Thulium was found to be paramagnetic above 51°K and possibly antiferromagnetic below 51°K. A.

538.22 : 537.312.62

MAGNETIC PROPERTIES OF SUPERCONDUCTORS.
See Abstr. 2337

538.221 : 539.217.1

2397. INFLUENCE OF POROSITY ON THE g-FACTOR OF FERRITES. J.Snieder.
Appl. sci. Res. B, Vol. 6, No. 5, 301-11 (1957).

Starting from the classical description of the ferromagnetic resonance phenomenon by Kittel, the author shows under what circumstances the experimental conditions comply with those taken for granted in the theoretical derivation. It is found that with the necessary corrections the derived resonance equation may be used for the experimental results. With the aid of cavity-techniques with ferromagnetic spheres the value of the spectroscopic splitting factor g was obtained. From quantum-mechanical considerations a g-value of nearly 2 is expected, which is independent of both temperature and frequency. Until now, all measurements on polycrystalline ferrites have given too high a value of g, which is moreover strongly dependent on temperature and frequency. Measurements by others on single crystals of the same material give a smaller g-value with a smaller frequency dependence and almost without any temperature dependence. A theoretical explanation of these discrepancies is given in this article. A.

538.221

2398. THE K_1- AND TRUE g-VALUES OF POLYCRYSTALLINE FERRITES. J.Snieder.
Appl. sci. Res. B, Vol. 6, No. 6, 471-3 (1957).

A continuation of previous work (see preceding abstract) on mixed Ni—Zn ferrites without porosity. Ferromagnetic resonance measurements were carried out between −40° and 100°C, and g was found to be independent of temperature and frequency, varying between 2.00 and 2.11 as the NiO content varied from 0 to 50%; the K_1 values are temperature dependent. E.P.Wohlfarth

538.221

2399. TIME DECREASE OF PERMEABILITY IN IRON. G.W.Rathenau.
J. appl. Phys., Vol. 29, No. 3, 239-42 (March, 1958).

Measurements on iron containing interstitial nitrogen are discussed. Relaxation phenomena with different relaxation times can be resolved. Unequal initial stiffness of the domain walls gives rise to satellites of the main relaxation. The activation energy of the main relaxation and its satellites coincides with that known for bulk diffusion. Short demagnetization of the relaxed material prior to time decrease results in wall movement during the measurement and in apparent longer relaxation times. The method has been applied for the determination of the activation volume for interstitial diffusion. Preliminary results of measurements on single crystals are given. A.

538.221

2400. STRUCTURE AND FERRIMAGNETISM OF THE ILMENITE COMPOUND $MnNiO_3$. E.F.Bertaut and F.Forrat.
J. appl. Phys., Vol. 29, No. 3, 247-8 (March, 1958).

$MnNiO_3$ is a ferrimagnetic compound, belonging to the ilmenite type. The sublattices of Mn^{4+} and Ni^{2+} are coupled antiferromagnetically as the sublattices of Fe^{3+} in hematite. The saturation magnetization at T = 0°K is $0.76\,\mu_B$. A.

538.221

2401. REPRODUCING THE PROPERTIES OF ALNICO PERMANENT MAGNET ALLOYS WITH ELONGATED SINGLE-DOMAIN COBALT-IRON PARTICLES.
F.E.Luborsky, L.I.Mendelsohn and T.O.Paine.
J. appl. Phys., Vol. 28, No. 3, 344-51 (March, 1957).

Single-domain particles of 40 : 60 Co—Fe alloy were prepared with a median diameter of 200 A, a median elongation of 5.4 : 1, and an intrinsic coercive force of 1950 Oe. By compacting these particles to various packing densities and degrees of alignment, shape-anisotropy fine-particle magnets were made with magnetic properties duplicating those of each of the Alnico permanent magnet alloys, including maximum-energy product-values above 5×10^6 G–Oe. It is concluded that the Alnico alloys and the fine-particle magnets derive their properties from very similar, but not identical, shape-anisotropy effects. A.

538.221

2402. DOMAIN STRUCTURE EFFECTS IN AN ANOMALOUS FERRIMAGNETIC RESONANCE OF FERRITES.
R.C.LeCraw and E.G.Spencer.
J. appl. Phys., Vol. 28, No. 4, 399-405 (April, 1957).

Measurements of the intrinsic tensor permeability $[\mu]$ of unsaturated Ni ferrite at 9300 Mc/s, using cavity perturbation techniques, have revealed an anomalous resonance for negative (anti-Larmor) circularly polarized fields. The resonance has a line width of 70 Oe and occurs very near the coercive force, which is 13.2 Oe. The usual resonance for positive (Larmor) circularly polarized fields occurs at 2750 Oe. An interesting consequence of the low-field resonance is that below saturation K'' is negative, where $K = K' - iK''$ is the off-diagonal component of $[\mu]$. Above saturation K'' is positive. The change in sign of K'' is shown not to violate energy considerations. These effects are explained by a theory involving r.f. demagnetizing poles on Bloch walls based on a model with a physically probable domain structure. The theory extends the Polder—Smit mechanism in unmagnetized media to include applied d.c. fields and circularly polarized r.f. fields. It is applicable to all ferrites, both mono- and polycrystalline, having domain walls free to move in d.c. fields of the order of the coercive force. Since the anomalous resonance depends upon the domain structure and appears to occur generally, it is a probe of considerable usefulness for the study of magnetization processes and h.f. phenomena in ferrites. A.

538.221

2403. FORM OF POLDER TENSOR FOR SINGLE CRYSTAL FERRITE WITH SMALL CUBIC SYMMETRY ANISOTROPY ENERGY.
H.Seidel and H.Boyet.
J. appl. Phys., Vol. 28, No. 4, 452-4 (April, 1957).

The Polder tensor susceptibility (Abstr. 1993/1949) is derived for the 110 plane of the cube, and its elements are exhibited as a function of the angle that the applied field makes with a cube edge, as well as of saturation magnetization, applied field, anisotropy constant and frequency. The analysis is valid for ferrites with anisotropy fields much less than externally applied magnetic fields. The tensor is no longer diagonal for circular polarizations, except along the 100 and 111 axes. A.

538.221

2404. HIGH-FIELD ANTIFERROMAGNETIC RESONANCE IN MnF_2 USING PULSED FIELDS AND MILLIMETER WAVELENGTHS. S.Foner.
Phys. Rev., Vol. 107, No. 3, 683-5 (Aug. 1, 1957).

Preliminary observations of the high-field antiferromagnetic

resonance mode in MnF_2 from 4.2°K up to T_N are presented. The experiments, which employ pulsed magnetic fields and relatively low frequencies (4 and 8 millimetre wavelengths), are briefly described. The absolute value and general temperature dependence of $(2H_E H_A)^{1/2}$ are in close agreement with estimates made earlier by Keffer and recent high-frequency measurements by Johnson and Nethercot (Abstr. 2419/1957) near T_N. The results demonstrate the general validity of the molecular-field approximation of antiferromagnetic resonance. Qualitative features of the resonance absorption and upper bounds of line widths are also presented. A.

538.221 : 548

2405. MAGNETIC ANISOTROPY OF COBALT FERRITE ($Co_{1.01}Fe_{2.00}O_{3.68}$) AND NICKEL COBALT FERRITE ($Ni_{0.72}Fe_{0.20}Co_{0.08}Fe_2O_4$). H.Shenker.
Phys. Rev., Vol. 107, No. 5, 1246-9 (Sept. 1, 1957).

A method of measuring the first magnetic anisotropy constant, K_1, of cubic crystals having a large anisotropy was developed which utilized measurements of the torque for directions of the applied field near the direction of easy magnetization. By this method K_1 of a cobalt ferrite crystal was found to be closely approximated by the empirical relationship $K_1 = 19.6 \times 10^6 \exp(-1.90 \times 10^{-5}T^2)$ ergs/cm³ from 20° to 325°K. Above 325° the measured anisotropy depended upon the length of time the crystal was in the magnetic field. For a nickel cobalt ferrite crystal, K_1, as measured by the usual torque method, was given empirically by $K_1 = [8.08 \exp(-3.57 \times 10^{-5}T^2) - 9.78 \exp(-0.863 \times 10^{-5}T^2)] \times 10^4$ ergs/cm³ from 20° to 600°K while K_2 increased from -4.7×10^4 ergs/cm³ at 20.5°, passed through zero at 190°, rose to a maximum of 1×10^4 at 280°K, and then above this temperature decreased rapidly to zero. The relationships for K_1 are of the same form as those found by Brükhatov and Kirensky for metallic ferromagnetic materials.

A.

538.221

2406. FERROMAGNETISM OF A ZIRCONIUM–ZINC COMPOUND. B.T.Matthias and R.M.Bozorth.
Phys. Rev., Vol. 109, No. 2, 604-5 (Jan. 15, 1958).

The compound with approximate composition $ZrZn_2$ was found to be ferromagnetic below 35°K with a saturation moment at the absolute zero of about 0.13 Bohr magnetons per molecule. The possible implications of this observation are briefly discussed.

D.J.Oliver

538.221

2407. ANTIFERROMAGNETISM IN THE BODY-CENTERED CUBIC Mn–Cr SOLID SOLUTION. J.S.Kasper and R.M.Waterstrat.
Phys. Rev., Vol. 109, No. 5, 1551-2 (March 1, 1958).

Neutron diffraction evidence for antiferromagnetism in an equiatomic solid solution of Mn and Cr, with the body-centred cubic structure, is presented. At 298°K the average moment per atom is $(0.85 \pm 0.04)\ \mu_B$. A.

538.221 : 538.65

2408. ON THE QUESTION OF PIEZOMAGNETISM. I.E.Dzyaloshinskiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 807-8 (1957). In Russian.

The assertion that piezomagnetic substances are forbidden by invariance arguments are shown to be incorrect by a discussion of the symmetry properties of antiferromagnetics. S.F.Edwards

538.221

2409. MAGNETIC PROPERTIES OF COBALT FLUORIDE IN THE ANTIFERROMAGNETIC STATE.
D.N.Astrov, A.S.Borovik-Romanov and M.P.Orlova.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 812-15 (1957). In Russian.

Measurements of magnetic susceptibility of CoF_2 in the range 20-250°K are reported and discussed.

538.222/.224

2410. DIAMAGNETISM AND PARAMAGNETISM [Diamagnétisme et paramagnétisme]. G.Foëx. PARAMAGNETIC RELAXATION [Relaxation paramagnétique]. C.J.Gorter and L.J.Smits.
Paris: Masson et Cie (1957) 317 pp. [Tables de constantes et données numeriques. Constantes séiectionnées, 7].

Complete compilation up to 1956 of magnetic susceptibilities, Curie temperatures, atomic moments, etc. for elements, alloys, inorganic and organic compounds, mixtures, free radicals etc. expressed in tabular form with references. Also a brief section on paramagnetic relaxation results up to 1950 is included.

D.H.Whiffen

538.222

2411. MAGNETIC SUSCEPTIBILITY OF TITANIUM (III) IN LANTHANUM TITANIUM OXIDES. C.W.Moeller.
J. chem Phys., Vol. 27, No. 4, 983-4 (Oct., 1957).

Room-temperature susceptibility measurements for La_xTiO_3 ($x = 0.92, 0.76, 0.70$) are reported, and the p_B values for the Ti (III) ions vary from 0.83 to 1.65 for this range of x.

E.P.Wohlfarth

538.222

2412. SURFACE PARAMAGNETISM OF GERMANIUM FILMS. Y.L.Sandler.
Phys. Rev., Vol. 108, No. 6, 1642 (Dec. 15, 1957).

The ortho–para conversion of hydrogen absorbed on sputtered Ge films indicates a low-temperature conversion having all the characteristics of magnetic spin inversion. The effect is attributed to the presence of unpaired electrons on the atomically clean parts of the film surface, possibly up to one per Ge surface atom.

C.A.Hogarth

538.24

2413. MAGNETIZATION CURVE OF THE INFINITE CYLINDER. A.Aharoni and S.Shtrikman.
Phys. Rev., Vol. 109, No. 5, 1522-8 (March 1, 1958).

The nucleation field for an infinite circular ferromagnetic cylinder, with the field applied along its axis, is rigorously calculated by exploring the whole eigenvalue spectrum of Brown's equations. The nucleation fields for cylinders with "large" radii are found to be those of the magnetization curling. For "small" radii the nucleation field is found to be somewhat smaller than that for the magnetization buckling. However, the difference is only about 1%, and the exact mode of reversal is very close to the buckling. The transition from exact buckling to curling is abrupt. These two modes are shown to be the only modes for nucleation for any radius, the other modes giving higher nucleation fields. It is shown that the magnetization reversal occurs in one jump, which means that the magnetization curve for the cylinder is a rectangular loop. A.

538.245

2414. MAGNETIZATION REVERSAL IN THIN FILMS AT LOW FIELDS. R.L.Conger and F.C.Essig.
J. appl. Phys., Vol. 28, No. 8, 855-8 (Aug., 1957).

A statistical theory of magnetization reversal in thin films for reversing fields less than the anisotropy field is presented in which it is assumed that reversal takes place by domain wall motion. The number of moving domain walls is determined by a simple statistical model which allows for the random nucleation of walls as the reversing field increases. Experimental data are presented in support of this theory. Two equations for the velocity of a domain wall in a thin film are presented; these arise since two alternative forms of the equation of motion of the magnetization vector are considered.

A.

538.27 : 538.652

2415. THE SATURATION MAGNETOSTRICTION OF NICKEL SINGLE CRYSTALS. R.R.Birss.
Proc. Phys. Soc. B, Vol. 70, Pt 11, 1093-6 (Nov., 1957).

Re-analyses the data of Masiyama (1928) and compares the results with those obtained from the measurements of Bozorth and Hamming (Abstr. 2578/1953). E.P.Wohlfarth

538.27 : 538.63 : 537.311.33

RESISTIVITY AND MAGNETORESISTANCE OF Au_2Mn. See Abstr. 2311

ELECTROMAGNETISM. ELECTRODYNAMICS

538.3 : 530.145

2416. REMARKS ON THE MEASURABILITY OF ELECTROMAGNETIC FIELDS. G.Heber.
Nuovo Cimento, Vol. 7, No. 5, 677-84 (March 1, 1958).

Indeterminacy relations are derived, which express the facts, that only 4-dimensional averages of electromagnetic fields are measurable and that also an average cannot be measured with unlimited accuracy simultaneously with the position of the averaging region in space-time continuum. Essentially in showing this is the use of test bodies, which obey Heisenberg's indeterminacy relations and possess a finite extension, finite mass and finite electric charge. A.

538.3

2417. MOTION OF A CHARGE PARALLEL TO THE AXIS OF A CYLINDRICAL CHANNEL IN A DIELECTRIC.
L.S.Bogdankevich and B.M.Bolotovskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1421-8 (1957). In Russian.

The field produced by a charge moving parallel to the axis of a cylindrical channel in a dielectric was determined. The field and energy losses of the charge are computed under various assumptions concerning the medium. A.

538.3 : 532.5

2418. ON THE FLOW OF A CONDUCTING FLUID ROUND MAGNETIZED BODIES. A.G.Kulikovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 2, 199-202 (1957). In Russian.

Regions in which there are magnetic fields caused by magnetized bodies are regarded as "cavities" into which liquid may flow (in the case of stationary flow and finite conductivity), and the magnetic fields in them are studied. The magnetohydrodynamical equations and boundary conditions for the system are given, and sufficient (but not necessary) additional conditions are imposed to determine a unique solution, which behaves correctly in the limit of infinite conductivity. Simplification occurs for a system with a plane or axis of symmetry. Detailed studies are made of the flow of an incompressible fluid round a plane of magnetic dipoles and the supersonic flow round a wedge and a cone on whose surfaces flow constant density currents. The flow pattern and behaviour of the magnetic lines of force for the last two cases are shown in a diagram. M.J.Kearsley

538.3 : 532.5

2419. THE DISSIPATION OF MAGNETIC ENERGY IN AN IONIZED GAS. T.G.Cowling.
Monthly Nat. Roy. Astron. Soc., Vol. 116, No. 1, 114-24 (1956).

A general formula is derived for the rate of dissipation of magnetic energy in an ionized gas. The formula is used to confirm Piddington's (Abstr. 9779, 9781/1955) value for the conductivity effective in producing dissipation. It is shown that, contrary to Piddington's assertions, an effective electric force must be taken into account when considering currents in the presence of a pressure gradient; however, this effective electric force has little effect on the dissipation. Piddington's results are completed by a general discussion of conductivity of a partially ionized gas. The results are applied to dissipation in interstellar gas; the effect of the magnetic field on the conductivity is shown to increase the rate of dissipation up to a point where the dissipation is not insignificant. A.

538.3 : 532.5 : 523.72

2420. THE VARIABILITY OF THE [SUN'S] MAGNETIC FIELD AND THE HEATING OF THE SOLAR ATMOSPHERE. V.I.Ivanchuk.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 4, 589-92 (1957). In Russian.

Considerable evidence suggests the existence of a general, variable magnetic field in the sun approximately satisfying the equation $\Delta t \sim l/H$, where Δt is the time of decay of the magnetic field, l is the size of the field and H its intensity. Three different (approximate) methods all lead to an estimate of the mean energy of the solar magnetic field of 10^{37} ergs. They are also applied less satisfactorily to the AO star HD 153 882. Using formulae of A.Ya.Kipper (Memoirs of 4th Conference on Cosmological Questions, Moscow, 1957) Δt is found to be 1/4 of the period of variability of the magnetic field. Using Cowling's current equation (see preceding abstract) an expression for the electrical conductivity $\sigma_\perp$ perpendicular to the magnetic field is obtained for a partially ionized gas, neglecting κ_e. For the solar chromosphere $\sigma_\perp \sim 3 \times 10^{10}$ c.g.s. units and for the corona $\sigma_\perp \sim 10^8$ c.g.s. units. Hence the energy loss inside the coronal material is found to be about 10^5 erg.cm^{-2}.sec^{-1}. From these results an explanation of the sharp boundary between the corona and the chromosphere is given. G.A.Chisnall

538.3 : 533.15

2421. PLASMA DIFFUSION IN A MAGNETIC FIELD.
M.N.Rosenbluth and A.N.Kaufman.
Phys. Rev., Vol. 109, No. 1, 1-5 (Jan. 1, 1958).

The equations governing the diffusion of a fully ionized plasma across a magnetic field are derived. It is assumed that macroscopic quantities vary slowly across an ion radius of gyration, and that the interparticle collision frequency is much less than the gyration frequency. The relevant transport coefficients — electrical resistivity, thermal conductivity, and thermoelectric coefficient — are derived. Some similarity solutions of the equations are found. A.

538.3 : 532.5

2422. THE AXISYMMETRIC SELF-EXCITED FLUID DYNAMO. G.Backus.
Astrophys. J., Vol. 125, No. 2, 500-24 (March, 1957).

The behaviour of axisymmetric magnetic fields maintained by electric currents in electrically conducting fluids of finite volume executing axisymmetric motion is studied at length. It is shown that the fluid motion cannot indefinitely increase any of the external multipole moments of the field, cannot prevent the decay of the external dipole moment, and cannot lengthen the decay time of the dipole moment by a factor of more than about 4 over its decay time in the absence of fluid motions. It is also shown that a certain weighted space average of the internal magnetic energy decays like the external dipole moment. When the fluid velocity is very high, an asymptotic expression for the rate of decay of the toroidal field is given. One application of these results is that if the geomagnetic field is maintained by a self-excited dynamo, the absence of axisymmetry of the field is probably essential to its generation and maintenance. A.

538.3 : 532.5

2423. INFLUENCE OF FLUID MOTIONS ON THE DECAY OF AN EXTERNAL MAGNETIC FIELD. L.Spitzer, Jr.
Astrophys. J., Vol. 125, No. 2, 525-34 (March, 1957).

Under conditions of simple symmetry it is shown that fluid motions within a body have a relatively minor effect on the decay rate of an external magnetic field in a vacuum surrounding the body. The magnetic field within the fluid, however, is profoundly influenced by the motions, with the large-scale field much reduced if strong convection currents are present. Two problems are analysed: an infinite cylinder, in which all quantities are independent of z, and a sphere with axial symmetry. In the first problem the decay rate of the net axial current, I_z, and of the corresponding external B_θ is almost entirely unaffected by the motions, provided that the cylinder radius is much smaller than the radius of the concentric outer cylinder in which the return current is assumed to pass. The equations for the decay of the magnetic vector potential, A_z, are identical with the equations for the change of temperature in a conducing fluid cylinder with the same two-dimensional velocities. In the second problem, in which compressible flow is assumed, the decay rate of the dipole moment, $\mathfrak{M}$, is generally not much affected by axisymmetric fluid motions. In both cases, however, the large-scale field within the fluid is much reduced in the presence of strong convection, and the external magnetic field is then produced by currents in localized regions, where the convection currents have a reduced effect. In the cylinder the axial current flows in a thin surface layer. In the sphere the currents flow both in a surface layer and in a cylindrical region inclosing the axis of symmetry, where the mean magnetic-field strength is increased by the convection. The increased ohmic dissipation resulting from high currents in localized regions is exactly offset by the work done on the magnetic field by the fluid velocities in these regions. A.

538.3 : 532.5

2424. THE STABILITY OF AN INFINITELY LONG CYLINDER WITH A PREVALENT FORCE-FREE MAGNETIC FIELD.
S.K.Trehan.
Astrophys. J., Vol. 127, No. 2, 436-45 (March, 1958).

The stability of an infinitely long cylinder of incompressible inviscid fluid of infinite electrical conductivity is investigated in case a magnetic field, which is force-free and has symmetry about the axis of the cylinder, prevails. It is found that the magnetic field increases the stability of the cylinder. The wavelength of the disturbance at which instability sets in for assigned strengths of the magnetic field are tabulated. A.

538.3 : 532.5

2425. DYNAMICAL INSTABILITY IN AN ANISOTROPIC IONIZED GAS OF LOW DENSITY. E.N.Parker.
Phys. Rev., Vol. 109, No. 6, 1874-6 (March 15, 1958).

It is shown that when the thermal motions of a tenuous ionized gas are sufficiently anisotropic, the gas, and the initially uniform magnetic field which the gas is assumed to contain, become unstable. One mode of instability occurs when the gas pressure is greater parallel to the field than perpendicular, and another mode when the pressure is greater perpendicular than parallel. It is suggested that such instabilities may be of astrophysical interest, particularly with regard to the configuration of the solar dipole field as it is drawn out into interplanetary space by ionized gas from the sun. A.

538.3 : 532.5 : 530.162

2426. IRREVERSIBLE STATISTICAL MECHANICS OF INCOMPRESSIBLE HYDROMAGNETIC TURBULENCE. R.H.Kraichnan. Phys. Rev., Vol. 109, No. 5, 1407-22 (March 1, 1958).

The irreversible statistical mechanics of incompressible hydromagnetic turbulence driven by external forces is treated by methods which do not require that the system be close to a state of detailed balance. The equations of motion are expressed in terms of linearly independent modes formed from the wave-vector components of velocity and magnetic fields, and the nonlinear interaction is exhibited as the sum of individually conservative three-mode interactions. A fundamental statistical equation is constructed giving necessary and sufficient conditions for all members of a distribution of time-functions to satisfy the equations of motion; it involves only second-, third-, and fourth-order distribution moments. A variational criterion is proposed for specifying a distribution consistent with the fundamental equation under physically appropriate constraints. It leads to a complete formal solution of the statistical problem. This solution is not exploited. Instead, two statistical hypotheses based on the assumption of high mode density are advanced. With their aid, each three-mode interaction is treated as a small perturbation on the motion due to all the three-mode interactions and the external forces. The moments in the fundamental equation for the stationary case thereby are expressed in terms of the diagonal elements of the time-covariance matrix and distribution-averaged infinitesimal-impulse-response matrix of the system. Closed equations are obtained which fix these matrix elements in terms of the covariance matrix of the external forces. If the statistical hypotheses are sound, this provides a theory of unbounded turbulence (infinite mode density) driven by Gaussian-distributed homogeneous forces which is exact at all Reynolds numbers based on r.m.s. velocity and the macroscale determined by the driving forces. The general theory is specialized to obtain integro-differential equations determining the covariance scalars and modal impulse-response functions for stationary, isotopic hydromagnetic turbulence. In the nonmagnetic case, the asymptotic inertial-range solution yields the wave-number spectrum $E(k) = 2\pi c(\epsilon v_0)^{\frac{1}{2}} k^{-\frac{3}{2}}$ and the modal time-autocorrelation function $J(2v_0 k\tau)/(v_0 k\tau)$, where v_0 is the r.m.s. velocity in any direction, ϵ is the mean rate of energy-cascade/unit-mass, and c is a universal number fixed by the theory. This contradicts the Kolmogorov similarity hypotheses; independent arguments are advanced against the latter. A.

538.3 : 532.5

2427. AN ANNULAR MAGNETO-VORTEX. V.D.Shafranov. Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 831-2 (1957). In Russian.

A solution has been found of the hydromagnetic equations for an annular vortex system with axial symmetry. S.F.Edwards

ELECTROMAGNETIC WAVES AND OSCILLATORS

538.561 : 532.5

2428. THE HYDROMAGNETIC OSCILLATIONS OF TWISTED MAGNETIC FIELDS. I. S.K.Trehan. Astrophys. J., Vol. 127, No. 2, 446-53 (March, 1958).

The stability of twisted magnetic fields confined to an infinitely long cylinder of incompressible inviscid fluid of infinite electrical conductivity is investigated when fluid motions are present along the lines of force and to an extent that the energies in the velocity and the magnetic fields are the same. It is found that the system is always stable. The periods of oscillation are given and discussed in the light of the corresponding stable modes of oscillation in the absence of fluid motions. A.

538.561 : 532.5

2429. THE HYDROMAGNETIC OSCILLATIONS OF TWISTED MAGNETIC FIELDS. II. S.K.Trehan and W.H.Reid. Astrophys. J., Vol. 127, No. 2, 454-8 (March, 1958).

The stability of twisted magnetic fields imbedded in a conducting fluid which extends to infinity is investigated when fluid motions are present along the lines of force. It is found that this configuration is always stable for cylindrically symmetric disturbances. The periods of oscillation are obtained by a variational method and are found not to differ greatly from the corresponding results for twisted magnetic fields confined to a cylinder of finite radius. A.

538.561 : 532.5

2430. HYDROMAGNETIC WAVES IN A HORIZONTALLY STRATIFIED ATMOSPHERE. V.C.A.Ferraro and C.Plumpton. Astrophys. J., Vol. 127, No. 2, 459-76 (March, 1958).

The propagation of hydromagnetic waves in a horizontally stratified atmosphere is of interest in connection with theories of sunspot magnetic fields and coronal heating. The problem was briefly discussed by Ferraro (1954), who assumed that both the particle velocity and the magnetic field variations were perpendicular to the magnetic field. The resulting motion is a simple Alfvén or A-wave, in which there is equipartition of kinetic and magnetic energy. In this paper the more general case is considered taking account of the compressibility of the gas. The associated waves, which may be termed "S-waves", are such that the particle velocity and magnetic-field variations have both horizontal and vertical components. They are of two main types, and, if the frequency is large, one of them is similar to an A-wave and the other behaves effectively as a sound wave. The A-type wave is characterized by the fact that the vertical components of the velocity and magnetic field variations are negligible. (These S-waves and A-waves are the analogues of the modified sound and Alfvén waves first discussed by van de Hulst, 1951). This corroborates Cowling's conclusion that gravity will tend to inhibit vertical motions in a hydromagnetic wave and, ipso facto, lends support to Cowling's criticism of Alfvén's theory of sunspots. The bearing of the result on the propagation of hydromagnetic waves in the solar chromosphere and corona is discussed, and it is tentatively suggested that the solar spicules may be explained on the basis of the sonic type of S-waves. A.

538.561

2431. PLASMA OSCILLATIONS IN A STEADY MAGNETIC FIELD: CIRCULARLY POLARIZED ELECTROMAGNETIC MODES. T.Pradhan. Phys. Rev., Vol. 107, No. 5, 1222-7 (Sept. 1, 1957).

Van Kampen's method (Abstr. 3042/1956) of treating the singularity which occurs in the solution of Boltzmann's equation for plasma oscillations is applied to the corresponding problem in the presence of a uniform external magnetic field. The propagation of electromagnetic waves in the direction of the field is considered in this paper. Expressions for the refractive index and damping of the waves are obtained which show striking departures from the Appleton—Hartree electromagneto-ionic theory near the cyclotron resonance frequency. A.

538.561

2432. WAVES IN A PLASMA IN A MAGNETIC FIELD. I.B.Bernstein. Phys. Rev., Vol. 109, No. 1, 10-21 (Jan. 1, 1958).

The small oscillations of a fully ionized plasma, in which collisions are negligible, in a constant external magnetic field, is treated by the Laplace transform method. The full set of Maxwell equations is employed and the ion dynamics are included. Various limiting cases are considered. It is shown that the self-excitation of waves around thermal equilibrium is impossible. It is also demonstrated that for longitudinal electron oscillations propagating perpendicular to the constant magnetic field, there are gaps in the spectrum of allowed frequencies at multiples of the electron gyration frequency, but zero Landau damping. These particular waves are also associated with a nonuniformity of convergence in the limit of vanishing magnetic field which phenomenon, however, is of no physical consequence. When the ion dynamics are included, two classes of low frequency oscillations are found, the existence of both of which has been predicted by the simple hydrodynamic theory, namely longitudinal ion waves, and transverse hydromagnetic waves. The well known results for the propagation of electromagnetic waves in an ionized atmosphere are also recovered, as well as the effects on such waves in various limiting cases of the magnetic field and particle motion. These calculations indicate that in many cases the transport equations are capable of yielding correct results, apart from such things as Landau damping, for a wide class of waves in a collision-free plasma. A.

538.561

2433. REACTION FIELD AND ITS USE IN SOME SOLID-STATE AMPLIFIERS. P.W.Anderson. J. appl. Phys., Vol. 28, No. 9, 1049-53 (Sept., 1957).

It is shown that the theory of the maser can be simply presented in terms of the concept of the radiation reaction field. This is the radiation field produced in a cavity or waveguide by the presence of the sample's electromagnetic moment. Its reaction back on the sample causes coherence effects such as those called "superradiance"

by Dicke (Abstr. 3248/1954). Two amplifiers using the radiation reaction field in different ways from the usual solid-state maser are discussed. One of them takes advantage of the nonlinearity of the equations of motion to make a modulated coupling between two cavity modes by means of a sample with three energy levels such as is used in Bloembergen's maser. The resulting amplifying mixer behaves the same as (but is different in principle from) Suhl's ferromagnetic amplifier. A second type of amplifier employs the reaction field to destroy the circular polarization of a paramagnetic resonance. It is then possible to make an amplifier from this using the principle of the subharmonic generator. A.

538.561 : 621.375.9

2434. MASER NOISE CONSIDERATIONS. J.Weber.
Phys. Rev., Vol. 108, No. 3, 537-41 (Nov. 1, 1957).

The contribution of the saturation field to the noise figure of a three-level maser is calculated. It is shown that the effect is very small, under ordinary circumstances. Certain aspects of spontaneous-emission noise are considered, and it is shown that the spontaneous-emission equivalent temperature for a free-electron, vacuum-tube amplifier is one-half that of a maser. The possibility of eliminating spontaneous-emission noise is considered, and it is concluded that more general quantum-mechanical amplifiers can, in principle, be constructed, which will not have spontaneous-emission noise.

A.

538.561

2435. CONTRIBUTION TO THE THEORY OF THE MOLECULAR GENERATOR. Yu.L.Klimontovich and R.V.Khokhlov.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1150-5 (1957). In Russian.

Processes of resonance interaction between an electromagnetic field and a molecular beam and self-oscillatory processes in a molecular generator of electromagnetic oscillations are examined. In distinction to other papers, the case of a beam of monochromatic (with respect to velocity) molecules is considered in detail. The result obtained by taking into account non-monochromatic molecules in the beam is discussed qualitatively. A.

538.566 : 621.372.8

2436. MODES IN RECTANGULAR GUIDES FILLED WITH MAGNETIZED FERRITE. G.Barzilai and G.Gerosa.
Nuovo Cimento, Vol. 7, No. 5, 685-97 (March 1, 1958).

A general modal solution for a rectangular guide, with a slab of ferrite against one side wall and magnetized in a direction parallel to this wall and normal to the axis of the guide, is found and the characteristic equation is obtained. By specializing this equation for the case of the completely filled guide, the relative characteristic equation is derived. A detailed discussion of this last equation, together with an analysis of the possible field configurations, is given. Numerical calculations are carried out in order to clarify the modes distribution. The preceding analysis is finally used to derive the modes cut-off dimensions for the completely filled guide.

A.

538.566.2 : 534.21

PROPAGATION OF WAVES THROUGH A SHEET OF A MEDIUM WITH A CUBIC PERIODIC STRUCTURE. See Abstr. 2191

538.569 : 539.19

RADIATION OF MOLECULES DUE TO H.F. ELECTRO-MAGNETIC FIELDS. See Abstr. 2020

NUCLEAR AND ATOMIC PHYSICS

APPARATUS. PARTICLE DETECTORS

539.1.07

2437. THE INFLUENCE OF THE EFFECTIVE LENGTH AND CYLINDER DIAMETER ON THE PLATEAU CURVE OF GEIGER—MÜLLER COUNTERS WITH GLASS TUBE AND EXTERNAL GRAPHITE [CATHODE]. D.Blanc.
Nuovo Cimento, Vol. 6, No. 4, 974-6 (Oct., 1957). In French.

Gives graphs of striking voltage v. L/b and plateau-length v. L/b for an external-cathode counter, (L = effective length, b = internal diameter of the counter tube). Argon—alcohol fillings were used. J.D.Craggs

539.1.07 : 537.591.15

2438. LARGE SCINTILLATOR FOR OBSERVATION OF COSMIC RAYS. J.R.Green.
Rev. sci. Instrum., Vol. 29, No. 1, 10-14 (Jan., 1958).

A liquid scintillator having an area of five square metres was developed for the observation of the extensive air showers in cosmic rays. The scintillating liquid, in the form of a disk 10 ft in diameter and 6 in. deep, is viewed by a single 14-in. Dumont type K 1328 photomultiplier tube. The associated circuitry provides a gate whose length is proportional to the logarithm of the scintillator pulse-height over a range in pulse height of 2000:1. The length of this gate can be either measured and recorded on a Berkeley EPUT timing meter or converted linearly to a pulse height and analyzed by a multichannel discriminator. A.

539.1.07

2439. LIQUID SCINTILLATORS FOR FREE NEUTRINO DETECTION. A.R.Ronzio, C.L.Cowan, Jr and F.Reines.
Rev. sci. Instrum., Vol. 29, No. 2, 146-7 (Feb., 1958).

The criteria by which liquid scintillators have been selected and developed for free neutrino detection experiments are described and a discussion is given of the preparation of the solutions. Triethyl-benzene is a superior solvent and cadmium octoate is found to be the best cadmium compound known for these purposes. A.

539.1.07

2440. SILICON CRYSTAL COUNTERS. W.D.Davis.
J. appl. Phys., Vol. 29, No. 2, 231-2 (Feb., 1958).

Pulses resulting from α-bombardment of an impurity-doped single crystal of silicon under an applied field of 10^3 volt/cm are described. Using gold electrodes in ohmic contact, the rapid rise of the primary pulses is followed by a much slower rise of secondary current, presumed to arise from the injection of electrons into the crystal by the field of trapped holes close to the cathode.

D.R.Chick

539.1.07

2441. A NEW WILSON CHAMBER OF LARGE DIMENSIONS. E.Fiorini, R.Giacconi and C.Succi.
Nuovo Cimento, Vol. 6, No. 4, 963-73 (Oct., 1957). In Italian.

Details of a large multiplate chamber (illuminated volume: $120 \times 114 \times 50$ cm^3) which can contain several tons of plates. Using overcompression it has been operated successfully with a 1.5 minute cycle. K.H.Barker

539.1.07 : 536.423.1

2442. ON THE BUBBLE CHAMBER. P.V.Vavilov.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1567-8 (1957). In Russian.

Brief outline of a theory which assumes that bubble formation is due to thermal processes (delta-ray energy converted to heat), in contrast to the usual theory (e.g. Abstr. 9729/1955). W.O.Lock

539.1.07

2443. ISOTHERMAL DEVELOPMENT TREATMENT OF THICK NUCLEAR EMULSIONS AT LOW TEMPERATURE. G.Marguin.
C.R. Acad. Sci. (Paris), Vol. 244, No. 18, 2304-6 (April 29, 1957). In French.

A new method for developing thick nuclear emulsions has been tried. It is based on keeping the emulsions at a constant temperature of 5°C throughout the process and by starting the development and arresting it after a given time by means of changing the pH of the solutions. By use of this technique the emulsions preserve their dimensions to a very high order, the distortion is therefore negligible; the clarity of the developed emulsions is also very good.

D.J.A.Prowse

539.1.07

2444. ON SOME ASPECTS OF PROCESSING THICK NUCLEAR EMULSIONS.
E.J.Burge, J.H.Davies, I.J.Van Heerden and D.J.Prowse.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 1005-8 (April, 1957).

It is pointed out that one apparent cause of blistering in the processing of thick nuclear emulsions can be eliminated by allowing the emulsions to dry for a period of not less than 36 hours after the rolling-on process has been completed. In the technique described, a high silver concentration in the fixing solution is avoided as it has apparently caused long fixing times and blisters. Some speculations are made on the possible mechanisms which result in the observed increase in the silver concentration during the fixing process.

D.J.A.Prowse

539.1.07

2445. DISTRIBUTION OF RANDOM POINTS ON A SURFACE. APPLICATION TO THE BACKGROUND OF NUCLEAR EMULSIONS. M.Morand, M.C.Le Gentil and S.Desprez-Rebaud.
C.R. Acad. Sci. (Paris), Vol. 245, No. 22, 1920-2 (Nov. 25, 1957). In French.

An analysis of the mean least distance, d, between points randomly distributed with a density ρ led to the relation $d = k/\rho^{1/2}$ with $k = 0.49 \pm 0.05$. Previous studies with nuclear emulsions confirm that a track will be visible if the mean distance between its grains is less than d, as calculated from this relation. E.J.Burge

539.1.07

2446. STOPPING OF DIFFUSION OF RADIOELEMENTS IN NUCLEAR EMULSION BY EXPOSURE TO LOW TEMPERATURE. M.Debeauvais, E.Picciotto and S.Wilgain.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 260-5 (Jan., 1957). In French.

It is shown that the diffusion of the radioelements in nuclear emulsions is probably stopped by the action of low temperature. The effects of the diffusion of radon were not observed at -85°C and of thoron at -36°C. At these respective temperatures, the distance observed between the stars and the single tracks is simply that corresponding to the expected distance for no diffusion. This method permits the use of nuclear emulsion to observe the characteristic phenomenon of the formation of stars for measuring very small quantities of radioelements. D.J.A.Prowse

539.1.07

2447. DIFFUSION OF RADIOELEMENTS OF THE Th FAMILY IN NUCLEAR EMULSIONS. N.Marongiu.
Nuovo Cimento, Vol. 6, No. 5, 1102-5 (Nov., 1957). In Italian.

In G5 emulsions, exposed to background radioactivity in dry conditions for 120 days, 3890 5-prong stars were found. Measurements show that diffusion of ThX and Tn had taken place in 55.2% and 25.6% of the stars respectively. K.H.Barker

539.1.07

2448. ON THE CHOICE OF THE MOST SENSITIVE PARAMETER TO THE VARIATION OF VELOCITY OF PARTICLES IN NUCLEAR EMULSION. Tsai-Chü and J.Claret.
C.R. Acad. Sci. (Paris), Vol. 244, No. 19, 2381-3 (May 6, 1957). In French.

It was found that the most sensitive parameters depend on the residual range of the particle. At the end of the range, the total gap-length is the best parameter and at minimum ionization, the total grain-length. Both these quantities have the greatest possible variation with velocity in their particular range. The measurement of total gap-length permits discrimination between protons and π-mesons having very small residual ranges. D.J.A.Prowse

539.1.07

2449. MEASUREMENT OF IONIZATION ON DIPPING TRACKS IN NUCLEAR EMULSION. R.C.Kumar.
Nuovo Cimento, Vol. 6, No. 3, 739-42 (Sept., 1957).

Theory and observations show that g, the reciprocal of the true mean gap length, is $\cos\theta$ times the apparent value where θ is the angle of dip in unprocessed emulsion. Lightly and heavily ionizing π-meson tracks were measured for θ up to 60°. E.J.Burge

539.1.07

2450. NOTE ON THE TRACK DENSITY OF MINIMUM-IONIZING PARTICLES IN LARGE EMULSION STACKS. B.Bhowmik, J.H.Davies, D.Evans and D.J.Prowse.
Nuovo Cimento, Vol. 7, No. 5, 712-14 (March 1, 1958).

On the basis of recent experience, it is suggested that Ilford G-5 emulsion stacks should be refrigerated after exposure when they are to be shipped over large distances by public transport. A.

539.1.07

2451. ON THE AUTOMATIC MEASUREMENT OF SCATTERING IN NUCLEAR EMULSION. V.Brisson-Fouché.
C.R. Acad. Sci. (Paris), Vol. 245, No. 21, 1800-3 (Nov. 18, 1957). In French.

An apparatus has been built which automatically makes the calculations necessary for the determination of the scattering of a track in photographic emulsion. A potentiometer circuit connected to the eyepiece cursor of a microscope gives values of the first differences when the cursor is set on the track manually. The charges on a series of condensers are used as a memory for performing the second difference calculation both for first and second cell sizes. The sum of the second differences is displayed on a series of neon tubes and the number of cells on a mechanical counter. The precision of the instrument has been tested to an accuracy of 5% which is a small error compared to that due to the small statistical weight usually involved in such scattering measurements. D.J.A.Prowse

539.1.07

2452. TWO-DIMENSIONAL PULSE-HEIGHT ANALYZER. M.Birk, T.H.Braid and R.W.Detenbeck.
Rev. sci. Instrum., Vol. 29, No. 3, 203-9 (March, 1958).

A two-dimensional analyser classifies a coincidence event between two detectors according to both pulse amplitudes. The events are sorted into "channels" covering a plane instead of the linear array of a conventional analyser. For coincidence measurements in which the amplitude spectrum from one detector is examined as a function of the pulse height from the other over a wide range, such a device provides maximum efficiency in recording the data. An analyser is described, in which each coincidence is recorded on a punched paper tape memory as a pair of correlated numbers (the two pulse heights) in binary notation (1-127). In the subsequent read-out these two numbers specify a two-dimensional channel. To examine the information in a particular region of the plane, a circuit controlled by a mechanical tape reader determines those events for which one coordinate lies in a preselected range. The corresponding coordinates are then displayed as a spectrum on a conventional 100-channel analyser by a digital-to-analogue conversion system in such a way that each event appears in the channel whose number is punched on the tape. The maximum recording rate is 8/sec; read-out is at 10/sec. The maximum number of channels is $(127)^2$. In experiments with low coincidence rates the time taken to record and analyse such data is very considerably less than by conventional methods. Examples are given of the application of the analyser to a $(p,p'\gamma)$ experiment and to the identification of energetic charged particles by measuring simultaneously their energy and differential energy loss. A.

539.1.07 : 539.14

2453. A CONTRIBUTION TO THE STUDY OF NUCLEAR PARAMAGNETIC RESONANCE IN VERY LOW FIELDS. J.M.Rocard.
Arch. Sci. (Geneva), Vol. 10, No. 3, 377-428 (July-Sept., 1957). In French.

A static magnetic field of ~ 1.5 Oe was produced by two pairs of coaxial coils (mean radii 12 cm, 47 cm, mean separation ~ 101 cm) which gave a homogeneity of 1 in 10^4 over 2 litres. Full details of the design are given. A crossed-coil spectrometer operating at 8.4 kc/s was used in two ways. The first method employed conventional low-frequency modulation of the static field and a complete study of the effects of the modulation frequency on line shape was made. In the second method an improvement in signal to noise ratio was obtained by phase sensitive detection at the Larmor frequency. The techniques were applied to the study of T_1 and T_2 in aqueous solutions of paramagnetic ions giving the result $T_1 = T_2$ in low fields. The gradient of the earth's field was obtained from the line-width of protons in distilled water. Finally the study of splittings due to indirect coupling in molecules gave results in agreement with the theory of Gutowsky. D.J.Oliver

539.1.07

2454. SPIN ECHO APPARATUS. J.Schwartz.
Rev. sci. Instrum., Vol. 28, No. 10, 780-9 (Oct., 1957).

A spin-echo apparatus is described which can measure nuclear relaxation effects for narrow resonances, convection and diffusion effects, and in some cases, chemical splittings in liquids. This apparatus is assembled mostly from commercial equipment. Commercial units used are identified, and circuit diagrams are given for specially constructed apparatus. Sufficient design information is given to make possible substitutions and improvements to suit the needs of particular projects. Necessary adjustment procedures are described and the relations of instabilities in the apparatus to instabilities in its components are treated. A.

ELEMENTARY PARTICLES

539.12

2455. OBSERVATION OF THE ANOMALOUS DECAY OF A CHARGED PARTICLE IN A WILSON CHAMBER. Z.Sh.Mandzhavidze, N.N.Roïnishvili and G.E.Chikovani.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 303 (1957). In Russian.

The secondary particle has transverse momentum of 351 MeV/c, which is too large for the known decay schemes of K-mesons and hyperons. W.O.Lock

539.12

2456. ON THE ROLE OF NUCLEONS IN THE PROCESS OF MULTIPLE PRODUCTION OF PARTICLES.
A.A.Emel'yanov and I.L.Rozental'.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 808-9 (1957). In Russian.

A hydrodynamic treatment to determine the fraction, E_k/E_0, of the incident energy, E_0, taken away by the fast nucleon in a nucleon–nucleon collision at energies 10^{11}–10^{12} eV. It is found that E_k/E_0 depends on energy approximately as $E_0^{-1/15}$.

W.O.Lock

539.12 : 530.145

MULTIPLE PARTICLE PRODUCTION. See Abstr. 2153

539.12

2457. ELASTIC SCATTERING OF POLARIZED PHOTONS.
D.Brini, E.Fuschini, L.Peli and P.Veronesi.
Nuovo Cimento, Vol. 7, No. 6, 877-90 (March 16, 1958).

Rayleigh's cross-section for a partially polarized photon beam may be expressed as: $d\sigma/d\Omega = d\sigma_0/d\Omega + \xi(d\sigma_1/d\Omega)$, where $d\sigma_0/d\Omega$ is the term resulting from the non-polarized component and $d\sigma_1/d\Omega$ that due to polarization, ξ being the beam polarization degree in respect to the scattering plane. By polarizing a photon beam through a Compton scattering, a given Rayleigh scattering angle θ being fixed, an asymmetry ratio may be defined by:

$$R = (d\sigma_0/d\Omega + \xi_{\parallel}(d\sigma_1/d\Omega))/(d\sigma_0/d\Omega + \xi_{\perp}(d\sigma_1/d\Omega)),$$

where the numerator is Rayleigh's cross-section for the angle θ in the Compton scattering plane, and the denominator is the same cross-section in the plane perpendicular to the Compton scattering one. R has been measured in the polarized photon elastic scattering, by using photons with a $0.64mc^2$ energy scattered on Hg with a $\theta \sim 90^0$ angle. The experimental results appear to be in conformity with the theoretical previsions. A.

539.12

2458. ON THE POSSIBILITY OF AN EXPERIMENTAL TEST OF DISPERSION RELATIONS FOR γ–PROTON SCATTERING.
M.Cini and R.Stroffolini.
Nuclear Physics, Vol. 5, No. 4, 684-92 (March, 1958).

The possibility of arriving at an experimental test of the dispersion relations for γ–proton scattering in a sufficiently reliable way, such that any observed discrepancy would be considered a proof against dispersion relations, is investigated. It is found that immediately above the threshold for pion photoproduction the best conditions are found, because the forward cross-section has a minimum, and its theoretical value is mainly determined by the dispersion integral containing the total photoproduction cross-sections for unpolarized γ's. A.

539.12

2459. GAMMA-RAY ABSORPTION AND OPACITY AT TEMPERATURES ABOVE 10^8 °K. S.N.Milford.
Astrophys. J., Vol. 125, No. 1, 213-20 (Jan., 1957).

At temperatures above 10^8 °K gamma-ray absorption is due to electron and photon–photon scattering plus pair-creation near nuclei and electrons and in photon–photon collisions. Each case is treated analytically, and estimates are made of the temperature at which it contributes significantly to the absorption, in preparation for later numerical calculations of the absorption and opacity. A.

539.12 : 523

GAMMA-RAY ASTRONOMY. See Abstr. 2093

539.12

2460. NEUTRINO MAGNETIC MOMENT UPPER LIMIT.
C.L.Cowan, Jr and F.Reines.
Phys. Rev., Vol. 107, No. 2, 528-30 (July 15, 1957).

A giant liquid scintillation detector was employed in a fission-reactor neutrino flux to set an upper limit of 10^{-9} Bohr magneton for the neutrino magnetic moment. The experiment consisted in searching for a count-rate difference associated with the reactor neutrinos. A.

539.12

2461. HELICITY OF NEUTRINOS.
M.Goldhaber, L.Grodzins and A.W.Sunyar.
Phys. Rev., Vol. 109, No. 3, 1015-17 (Feb. 1, 1958).

Neutrinos are shown experimentally to have negative helicity (left handed). This conclusion is based on the observation of the circular polarization of the γ-rays produced in the decay of the 9.3 hr isomer of Eu^{152}: Eu^{152m}(K-capture)$Sm^{152*}(\gamma)Sm^{152}$, which undergo resonant scattering in Sm^{152}. It depends on the assignment (0–) for the initial nucleus. Concerning the less plausible assignments (1–) and (1+) it is shown that for (1–) the results still indicate negative helicity, but the calculations for the assignment (1+) are not yet complete. The results indicate that the Gamow–Teller interaction is axial vector for positron emitters. S.J.Goldsack

539.12

2462. VARIATION OF ELECTRON MASS WITH VELOCITY.
F.C.Champion.
Nuovo Cimento, Vol. 7, No. 1, 122 (Jan. 1, 1958).

The comparison between electron collision experiments and the Lorentz formula is reconsidered and found in significant agreement, in disagreement with the comments of Farago and Janossy (Abstr. 8370/1957). S.F.Edwards

539.12

2463. MEASUREMENT OF THE PRIMARY SPECIFIC IONIZATION OF ELECTRONS USING A WILSON CHAMBER.
J.Allewaert, R.Van de Walle and J.Verhaeghe.
C.R. Acad. Sci. (Paris), Vol. 245, No. 19, 1611-14 (Nov. 4, 1957). In French.

Using a magnet-chamber, measurements were made on 637 tracks due to electrons, with energies of from 0.1 to 1.7 MeV, in H_2,He, and O_2. The measured primary ionizations in both H_2 and He, after correction for background and vapour droplets, are significantly greater than those predicted by the Bethe–Fermi theory. K.H.Barker

539.12

2464. PROBLEMS POSED BY THE CAUSAL INTERPRETATION OF PAULI'S HYDRODYNAMICAL EQUATIONS. P.Hillion.
C.R. Acad. Sci. (Paris), Vol. 245, No. 20, 1703-5 (Nov. 13, 1957). In French.

The problem of the radiation of an electron is studied within the framework of the causal interpretation given in a previous note (Abstr. 45/1958). To the hypotheses mentioned there are added: (1) that the physical electron is accompanied by a virtual field of photons and pairs with which it exchanges energy; (2) comparing the virtual field to an assembly of oscillators, the energy exchange occurs when the frequency of one of the field oscillators has the value $\nu_e = w/h$ (where dw/dt is the rate of energy exchange); (3) the emission and absorption of energy by the electron takes place in the course of a resonance established whilst the electron wave is changing between the initial and final states. It is suggested that the mechanism may be described by non-linear equations. M.J.Kearsley

539.12

2465. THE ELECTRON–ELECTRON SCATTERING WITH LONGITUDINAL POLARIZED ELECTRON BEAM.
K.Nagy and I.Farkas.
Nuovo Cimento, Vol. 7, No. 4, 570-4 (Feb. 16, 1958).

The differential cross-section for scattering of longitudinally polarized electrons on polarized electrons is calculated in lowest-order perturbation theory. J.C.Taylor

539.12

2466. POLARIZATION OF ELECTRONS SCATTERED BY THIN GOLD FOILS. W.G.Pettus.
Phys. Rev., Vol. 109, No. 5, 1458-60 (March 1, 1958).

The polarization of electrons by scattering from thin gold foils was observed in a double-scattering experiment. The azimuthal asymmetry in the distribution of the twice-scattered electrons was measured in the energy range from 80 to 190 keV and for scattering angles of 60, 90, and 120 degrees. The observed asymmetries are somewhat smaller than would be expected from the calculations of Mohr and Tassie for the screened field of gold but the predicted increase in asymmetry for increasing scattering angles is confirmed. A.

539.12 : 537.533.79

AN EXPERIMENT FOR POLARIZATION OF FREE ELECTRONS. See Abstr. 2356

539.12

2467. BACKSCATTERING OF POSITRONS FROM Na^{22}.
A.Cambieri and R.Pappalardo.
Nuovo Cimento, Vol. 6, No. 3, 743-4 (Sept., 1957). In Italian.

Experiments on a number of metals and alloys have confirmed that the number of particles backscattered within a given solid angle is proportional to the square root of the atomic number (or effective atomic number) of the scatterer. L.Pincherle

539.12

2468. SEMIPHENOMENOLOGICAL TWO-NUCLEON POTENTIAL. P.S.Signell and R.E.Marshak.
Phys. Rev., Vol. 109, No. 4, 1229-39 (Feb. 15, 1958).

It is found that a good fit of the unpolarized and polarized two-nucleon scattering data up to 150 MeV can be obtained by adding a phenomenological short-range attractive spin–orbit potential to the meson-theoretic Gartenhaus potential (which contains both central and tensor terms). It is shown that the deep attractive wells which result for certain states can be modified so as to eliminate all undesirable bound states without hurting the fit with the scattering data (at least up to 150 MeV). The prediction of the combined Gartenhaus–spin–orbit potential are examined at 210 and 300 MeV. While the addition of a spin–orbit potential helps materially at these higher energies, it is likely that a precision fit of the 300 MeV scattering will require additional terms in the two-nucleon interaction (containing higher powers of the nucleon momentum than the first). A.

539.12

2469. CONSERVATION OF THE NUMBER OF NUCLEONS. F.Reines, C.L.Cowan,Jr and H.W.Kruse.
Phys. Rev., Vol. 109, No. 2, 609-10 (Jan. 15, 1958).

Neutron associated delayed coincidences in a well-screened large liquid scintillator containing D_2O, H_2O and $CdCl_2$ were observed. The counting rate observed was consistent with that expected from cosmic rays and an improved value for the lifetime for spontaneous decay of nucleons of 4×10^{23} year was obtained. L.L.Green.

539.12

2470. MINAMI TRANSFORMATION FOR NUCLEON–NUCLEON SCATTERING. R.Ryndin and Ya.A.Smorodinskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1200-5 (1957). In Russian.

It is shown that in the case of nucleon–nucleon scattering no analogue exists to the shift transformation (existing in the case of π-meson scattering on nucleons) which leaves the scattering cross-section invariant. In this case a rotational transformation of the spins does not yield new phase-shift sets which possess physical meaning. A.

539.12

2471. CONTRIBUTION TO THE THEORY OF EXCHANGE COLLISIONS BETWEEN FAST NUCLEONS AND DEUTERONS. L.I.Lapidus.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1437-41 (1957). In Russian.

It is shown that under some general assumptions regarding the nucleon–nucleon scattering amplitude, comparison of the experimental data on exchange scattering of fast nucleons by deuterons with the results of computations carried out in the momentum approximation can be of aid in phase-shift analysis of scattering of neutrons by protons. The phase-shift analysis carried out by Klein does not agree with the experimental data on n–d exchange scattering. A.

539.12

2472. APPLICATION OF CHARGE INVARIANCE TO POLARIZATION PHENOMENA. S.M.Bilen'kiĭ.
Zh.éksper. teor. Fiz., Vol. 33, No. 3(9), 821-2 (1957). In Russian.

Relations are obtained, under the hypothesis of charge independence, between the polarizations produced in various pion–nucleon and nucleon–nucleon scattering experiments. P.K.Kabir

539.12

2473. PHASE SHIFTS FOR p–α SCATTERING AND POLARIZATION IN p–α SCATTERING FOR PROTON LABORATORY ENERGIES FROM 0 TO 40 MeV. J.L.Gammel and R.M.Thaler.
Phys. Rev., Vol. 109, No. 6, 2041-7 (March 15, 1958).

The phase shifts for p–α scattering as a function of energy are known below about 10 MeV from previous phase-shift analysis work. New scattering and polarization data at 17.5 MeV and scattering data at 40 MeV make possible the extrapolation of these phase shifts up to about 40 MeV. This is accomplished by means of phase-shift analyses of the data, taken together with an analysis in terms of an effective two-body potential. It is found that the polarization in p–α scattering is always large in this energy region. Curves are given for the angular distribution of polarization in the energy range 10-40 MeV. A.

539.12

2474. POLARIZATION CORRELATION IN NUCLEON–NUCLEON SCATTERING. A.G.Zimin.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1226-32 (1957). In Russian.

Formulae for polarization correlation in proton–proton scattering were obtained taking into account four phase-shifts: $^1S_0$, $^3P_0$, $^3P_1$, $^3P_2$ and Coulomb interaction. Calculations, in which phase-shifts for isotropic states deduced from scattering data are used, indicate that Coulomb interaction is significant at energies of 10-30 MeV. Polarization correlation can thus be used to determine with greater precision the energy dependence of isotropic phase-shifts (which are not associated with polarization) and to estimate other phase-shifts in the energy range in which they begin to appear. The scheme of an experiment for measurement of polarization correlation is discussed and combinations of the polarization tensor components, which can be measured experimentally are obtained. A.

539.12

2475. THE LIQUID HELIUM BUBBLE CHAMBER AS ANALYZER OF PROTON POLARIZATION. G.J.Lasinio and G.C.Moneti.
Nuovo Cimento, Vol. 6, No. 4, 989-93 (Oct., 1957).

Superior to conventional techniques, since a broad energy range can be analysed over a large solid angle. It is claimed that the Fermi and Yang phase-shifts could be distinguished if 200 recoil protons (estimated running time about one day), from π^+–p scattering, were analysed in this way. K.H.Barker

539.12

2476. DIFFRACTION OF NEUTRONS BY IMPERFECT GASES. R.M.Mazo and A.C.Zemach.
Phys. Rev., Vol. 109, No. 5, 1564-72 (March 1, 1958).

The theory of cluster expansions is studied by a new method. A general procedure for obtaining the thermal average of a many-body function as a series in powers of density is derived. A recipe based on the Baker–Hausdorff theorem for reducing quantum thermal averages to their classical analogues is also described. These results are used to express the slow neutron cross-sections of imperfect gases as power series in molecular density. Formulae are given for the leading contributions to both elastic and inelastic scattering. A.

539.12

2477. EFFECTIVE BOUNDARY CONDITION AT THE SURFACE OF SEPARATION OF A MULTIPLYING AND A RETARDING MEDIUM. A.Akhiezer, N.Akhiezer and G.Lyubarskiĭ.
Zh. tekh. Fiz., Vol. 27, No. 4, 822-9 (1957). In Russian.

This condition is derived for thermal neutrons for the case in which the retarding properties of the two media are identical. W.O.Lock

539.12 : 539.14

CALCULATION OF THE POLARIZATION OF NEUTRONS IN A NUCLEAR MODEL WITH A SMOOTH EDGE. See Abstr. 1897

539.12

2478. MESONIUM AND ANTIMESONIUM. B.Pontekorvo [Pontecorvo].
Zh. eksper. teor. Fiz., Vol. 33, No. 2(8), 549-51 (1957). In Russian.

The special properties of systems, where the particle–antiparticle transition is not forbidden, are considered for the case of μ-mesonium (muonium). No observable effects are predicted It is suggested that, if lepton charge is not conserved, this may be of interest in the theory of the neutrino. G.H.Burkhardt

539.12

2479. SEARCH FOR MASS-500 PARTICLE AS A K^+ DECAY PRODUCT. G.Harris, J.Orear and S.Taylor.
Nuovo Cimento, Vol. 6, No. 5, 1232 (Nov., 1957).

If a 500 m_e particle exists it would have a characteristic range if it originated in the two-body decay of a K^+-meson. From a sample of 5000 K^+ endings, 32 secondaries originally classified as μ-mesons were carefully grain-counted near their origins. These measurements confirm that they are in fact μ-mesons. K.H.Barker

539.12

2480. MESON PRODUCTION IN HIGH-ENERGY NUCLEON COLLISIONS. É.G.Bubelev.
Zh. éksper. teor. Fiz., Vol. 33, No. 2(8), 539-40 (1957). In Russian.

539.12

2481. DISPERSION RELATIONS FOR S- AND P-WAVES IN THE MESON PHOTOPRODUCTION REACTION IN THE FIRST APPROXIMATIONS TO 1/m. L.D.Solov'ev.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 801-3 (1957). In Russian.

To derive a dispersion relation one needs to know the behaviour of the amplitudes in the unphysical region. This can be discovered if one assumes that the amplitude can be expanded in terms of angular momentum states and terminated. Dispersion relations are deduced on the basis of this assumption. W.O.Lock

539.12

2482. INVARIANTS IN MUON DECAY. R.Gatto and G.Lüders.
Nuovo Cimento, Vol. 7, No. 6, 806-20 (March 16, 1958).

The assumption of vanishing neutrino mass leads to a group of transformations of the neutrino field which leave commutation relations and free-field Hamiltonian invariant but change the interaction into an equivalent one giving the same physical results. This concept, which is attributable to Pursey and Pauli, is applied to $\mu-e$ decay under the assumption of local non-derivative coupling with no restrictions as to conservation of parity or lepton charge. The physically relevant invariant combinations of coupling constants are derived, and relations between them are discussed. Use is made of a paper by Kinoshita and Sirlin to express all experimental information on $\mu-e$ decay in terns of these invariants. A.

539.12

2483. ON THE SPIN OF THE MUON.
L.M.Brown and V.L.Telegdi.
Nuovo Cimento, Vol. 7, No. 5, 698-705 (March 1, 1958).

The distribution in angle and energy of the electron arising from the decay of a longitudinally polarized muon of spin $\frac{1}{2}$ is calculated, using the most general parity nonconserving direct interaction. The result depends upon three parameters (functions of the coupling constants) which cannot be adjusted to give agreement with experiment. A.

539.12

2484. DETERMINATION OF THE COUPLING CONSTANTS IN $\mu^- + p \rightarrow n + \nu$. L.Wolfenstein.
Nuovo Cimento, Vol. 7, No. 5, 706-11 (March 1, 1958).

For the reaction $\mu^- + p \rightarrow n + \nu$ the results of possible experimental observations including the neutron polarization are calculated on the basis of the two-component neutrino theory. In the non-relativistic approximation these observations overdeterminé the coupling constants, but relativistic effects, which are included in the calculation, are quite important for certain values of the coupling constants. A.

539.12 : 539.17

2485. A THEORETICAL ESTIMATE OF THE INFLUENCE OF THE CHARACTER OF THE FOUR-FERMION INTERACTION ON THE MUON CAPTURE RATE. H.A.Tolhoek and J.R.Luyten.
Nuclear Physics, Vol. 3, No. 5, 679-88 (July, 1957).

The four-fermion interaction for muon capture may contain the Fermi interaction as well as the Gamow–Teller interaction, similar to the situation for the beta-radioactivity. Theoretical calculations of the muon-capture rate were made for both types of interaction for the nuclei from Ca to Ni, assuming nuclear shell structure. It follows that an experimental determination of the ratio of Fermi to Gamow–Teller interaction should be feasible by measuring the ratio of muon-capture rates in suitably chosen nuclei (preferably the separated isotopes, although the use of the natural isotope mixtures is not quite excluded). The ratio of the capture rates for two nuclei differs often up to 50% for Fermi and Gamow–Teller interaction. As several simplifying assumptions were made, the results of the calculations may have more qualitative than quantitative significance; however, the results obtained seem to justify further theoretical and experimental work on the subject. The published experimental data do not allow to draw any conclusions with certainty, but may contain an indication for preponderant Gamow–Teller interaction. A.

539.12

2486. CAPTURE OF μ^- MESONS BY PROTONS.
K.Huang, C.N.Yang and T.D.Lee.
Phys. Rev., Vol. 108, No. 5, 1340-5 (Dec. 1, 1957).

By use of a two-component theory of the neutrino the capture process and the radiative capture process of a μ^- by a proton is analysed in detail. A.

539.12

2487. NOTE ON THE POLARIZATION OF THE MUON IN $K_{\mu 3}$.
S.Furuichi, S.Sawada and M.Yonezawa.
Nuovo Cimento, Vol. 7, No. 5, 718-19 (March 1, 1958).

Measurement of the muon polarization in the direction of the pion momentum would afford good evidence for the form of the interaction, irrespective of the energy dependence of the effective coupling constants. J.C.Taylor

539.12

2488. INVESTIGATION OF CORRELATIONS IN $\pi \rightarrow \mu \rightarrow e$ DECAYS.
A.O.Vaĭsenberg and V.A.Smirnitskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1340-3 (1957). In Russian.

The energies for 120 positrons from $\pi-\mu-e^+$ decays in photographic emulsions and the angle between the directions of emission of the μ-meson and positron have been measured. It is shown that the distribution obtained is in qualitative agreement with the theory of the two-component neutrino. For the product of the parameter λ of this theory and the relative number (α) of μ-mesons which did not suffer depolarization in the emulsion the value $\alpha\lambda = 0.50 \pm 0.25$ has been obtained. A.

539.12

2489. ON THE POSSIBILITY OF $\pi \rightarrow e + \nu + \gamma$ DECAY.
I.Yu.Kobzarev.
Zh. éksper. teor. Fiz., Vol. 33, No. 2(8), 551-3 (1957). In Russian.

Because of the strong interaction between π-mesons and nucleons the decay $\pi \rightarrow e + \nu$ may occur through the β-decay of one of the virtual nucleons into which a π-meson may dissociate. If the β-decay interaction is taken to consist of scalar (S) and tensor (T) variants, it is clear that the T-interaction may not contribute to the process nor may the scalar unless the heavy-particle brackets contain pseudoscalars [this would usually be called P]. However, the process described in the title may occur, and it is calculated in lowest-order perturbation theory. Cutting off a logarithmically divergent integral for the nucleon loop at an energy of the order of the nucleon mass, and taking $G^2/4\pi = 10$, the branching ratio for this mode of π-meson decay is found to be $\rho_\gamma \sim 10^{-4}$. Cassel's experimental value is $\rho_\gamma < 2 \times 10^{-6}$. P.K.Kabir

539.12

2490. MEAN FREE PATH OF 4.3 GeV π^--MESONS IN NUCLEAR EMULSIONS. A.Marques, N.Margem and G.A.B.Garnier.
Nuovo Cimento (Ser. 10), Vol. 5, No. 1, 291-2 (Jan., 1957).

This was measured by line scanning 18 metres of π^--meson track length in nuclear emulsion. 57 interactions (both elastic and inelastic) were found giving a mean free path of 33.7 ± 4.7 cm. This result is compared with those of other workers and it is concluded that the cross-section per emulsion nucleus is constant at ~ 600 millibarn between 1 BeV and 100 BeV. D.J.A.Prowse

539.12

2491. POLARIZATION OF RECOIL PROTONS IN PION–PROTON SCATTERING. Hong-Yee Chiu.
Phys. Rev., Vol. 107, No. 5, 1468 (Sept. 1, 1957).

It is pointed out that a measurement of the polarization of the recoil protons in π-meson–proton scattering would provide experimental evidence to distinguish between the Fermi and Yang phase-shifts. The angular distribution of the polarization of the protons resulting from the scattering of 220 MeV π^--mesons is calculated and it is found that the results for the two solutions should be readily distinguishable. The interactions in D-states have been neglected although they would show up by the appearance of a $\sin 2\theta$ term. D.J.A.Prowse

539.12

2492. NEUTRAL PIONS FROM PROTON–PROTON COLLISIONS.
R.A.Stallwood, R.B.Sutton, T.H.Fields, J.G.Fox and J.A.Kane.
Phys. Rev., Vol. 109, No. 5, 1716-22 (March 1, 1958).

The production of neutral pions in p–p collisions was measured from 346 to 437 MeV. The method was to detect single photons at laboratory angles of 30^0, 60^0, and 90^0 from the decay of neutral pions in the reaction $p + p \rightarrow \pi^0 + p + p$. Total cross-sections which were obtained in this experiment and previous results for proton energies near threshold, have an energy dependence consistent with the phenomenological theory. Additional data were obtained on neutral pion production in proton bombardment of several complex nuclei from Li to Pb. A cross-section for bound neutrons was obtained by a comparison of results from H_2O and D_2O targets. A.

539.12

2493. PION PRODUCTION IN PION–NUCLEON COLLISIONS.
R.M.Sternheimer and S.J.Lindenbaum.
Phys. Rev., Vol. 109, No. 5, 1723-33 (March 1, 1958).

The single production of pions occurring in pion–nucleon collisions at incident pion energies below ~ 1.5 BeV is considered in terms of the inelastic excitation of the nucleon to the isobaric state with isotopic spin and angular momentum = $\frac{3}{2}$, previously identified with the resonant state in the low-energy pion–nucleon scattering. An associated separate recoil pion accompanies the isobar, and conserves energy and momentum. The isobar subsequently decays into a nucleon and a pion. Expressions are obtained for the branching ratios between the different reactions, $\pi^- + p \rightarrow \pi^- + \pi^+ + n$, and $\pi^- + \pi^0 + p$, and for the separate energy spectra of the π^+, π^0, and π^- mesons. The momentum distributions of the pions and recoil nucleons are calculated at incident pion energies of 0.93 BeV and 1.37 BeV, and are generally in reasonable agreement with the experimental data available at these energies. A.

539.12

2494. EVIDENCE FOR THE PRODUCTION OF A NEUTRAL PION IN AN ANTIPROTON ANNIHILATION EVENT.
G.M.Frye, Jr and A.H.Armstrong.
Phys. Rev., Vol. 110, No. 1, 170-2 (April 1, 1958).

An antiproton of kinetic energy 110 MeV annihilated in flight, producing a star in nuclear emulsion with three charged mesons and four heavier particles. An electron–positron pair was found 76 μ from the vertex and closely aligned with it. The pair is best explained as resulting from a γ-ray from the decay of a π^0 meson which was formed in the annihilation. The most likely interpretation of the event is that the antiproton annihilated with a proton in N^{14} or O^{16} with the production of two positive pions, a neutral pion and a negative pion all of which escaped the nucleus; and a negative pion which was absorbed. The pion energies, including $m_\pi c^2$, are as follows (in MeV): π^+, 214 ± 2; $\pi^\pm$, 635 ± 138; $\pi^\mp$, 628 ± 131; π^0, $190 < E_{\pi^0} < 400$; π^-, $290 < E_{\pi^-} < 480$. A.

539.12

2495. DISTORTED WAVE APPROXIMATION IN THE REACTION $p + p \rightarrow \pi^+ + d$. B.Durney.
Proc. Phys. Soc., Vol. 71, Pt 4, 654-7 (April, 1958).

The improvement in the agreement between theory and experiment in the threshold region of π^+-meson production from proton–proton collisions is shown to be independent of any detailed model of the meson–nucleon interaction in the final state. The distorted-wave approximation applied to the resonant scattering state gives a marked increase in the production cross-section over the cross-section calculated in Born approximation. A.

539.12

2496. RESONANCE INTERACTION OF A π-MESON WITH NUCLEONS AND π-MESON PRODUCTION BY NUCLEONS. L.M.Soroko.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1136-42 (1957). In Russian.

An attempt is made to approximately take into account the strong π-meson–nucleon interaction in processes involving production of single π-mesons ($N + N \rightarrow \pi + N + N'$). The calculations are carried out on the assumption that the energy of the $N + N \rightarrow \pi + N + N'$ process depends on the energy of the produced π-meson with respect to one of the nucleons. The matrix element formalism for nuclear reactions is employed in the calculations. The π-meson–nucleon interaction matrix element values, determined from experimental data on the π-meson–nucleon total interaction cross-sections, were used to compute the π-meson and nucleon spectra for the $N + N \rightarrow \pi + N + N'$ reaction and the dependence of π-meson emission probability on the angle between the π-meson and nucleon directions (angular correlation). The results of the calculations are compared with the experimental data. A.

539.12

2497. PRODUCTION OF π-MESONS ON PARTICLES OF ZERO ISOTOPIC SPIN.
A.G.Meshkovskiĭ, Yu.S.Pligin, Ya.Ya.Shalamov and V.A.Shebanov.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1328-34 (1957). In Russian.

The energy spectra and differential cross-sections for production of π^+- and π^--mesons on deuterium and of π^--mesons on carbon were measured for a proton energy of 660 MeV and an observation angle of 45° with respect to the beam. Comparison of the data on production of charged and neutral mesons confirms the correctness, for deuterium and carbon, of the relation $d\sigma^+ + d\sigma^- = 2d\sigma^0$ which follows from the hypothesis of isotopic invariance for zero isotopic spin nuclei. A.

539.12

2498. DISPERSION RELATIONS FOR PHOTOPRODUCTION OF MESONS ON NUCLEONS. A.A.Logunov and A.N.Tavkhelidze.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1383-403 (1957). In Russian.

Dispersion relations for π-meson photoproduction reactions on nucleons were obtained. The spin and isotopic structure of the reaction amplitude were established. The unobservable energy range was separated. It is proved that the dispersion relations are inhomogeneous. A.

539.12

2499. "COMPOSITE" MODEL FOR K-MESONS. S.N.Biswas.
Nuovo Cimento, Vol. 7, No. 5, 577-600 (March 1, 1958).

It is proposed that the heavy mesons are composite and are excited bound states of two pions. The interaction between the two pions is assumed to be due to a pseudoscalar field with direct coupling. To predict the K-mesons the interaction strength, g^2, is found to be equal to, or rather greater than $1.789\,\pi(\mu/m)$. The usual procedure of the renormalization of the pseudoscalar and scalar theories is used to obtain the covariant wave-equation describing the two-boson bound system. The complete and separable solutions of the wave equation predict the existence of a new "quantum number" whose properties are similar to those of the "dionic" number or the "strangeness" number proposed by other authors. The decay of the K-mesons is studied on the basis of a Universal Fermi interaction. The life-time turns out to be $\approx 10^{-7}$ sec, in reasonable agreement with the observed time. The associated production of the strange particles is explained with the help of Feynman diagrams on the assumption of conservation of the new relativistic quantum number. A.

539.12

2500. FURTHER EVIDENCE FOR A LONGLIVED NEUTRAL K-PARTICLE. S.v.Friesen and K.Kristiansson.
Nuovo Cimento (Ser. 10), Vol. 5, No. 4, 1013-15 (April, 1957).

An event which is attributed to the nuclear interaction of a neutral K-particle was found in a stack exposed to the K^+-meson beam of the Berkeley Bevatron. The event consists of double stars 1166 μ apart. The interconnecting track was identified by mean-track-width measurements as being due to a Li^8 hyperfragment. The first star has no apparent primary and it is assumed that it must have been caused by a neutral particle of strangeness, -1. As the stack was exposed to a K^+-meson beam and not a K^--beam, the neutral particle must have come from the target and be an example of a long-lived neutral K-meson which has manifested itself as a particle of -1 strangeness number on interaction. D.J.A.Prowse

539.12

2501. POSSIBLE METHOD FOR DETERMINING THE INTRINSIC PARITY OF THE K MESON. G.Costa and B.T.Feld.
Phys. Rev., Vol. 109, No. 2, 606-7 (Jan. 15, 1958).

In K-meson production processes of the kind $N + N \rightarrow N + Y + K$, the secondary nucleon and hyperon may sometimes behave as if they were "almost bound" (like the di-neutron). In such cases, the parity of the K-meson could be determined from an analysis of its energy and angular dependence. J.C.Taylor

539.12

2502. ELECTROMAGNETIC INTERACTION OF THE NEUTRAL K MESON. G.Feinberg.
Phys. Rev., Vol. 109, No. 4, 1381-4 (Feb. 15, 1958).

The electromagnetic interaction of a spinless neutral particle, which is different from its antiparticle, is discussed. It is shown that while such particles cannot emit a free photon, or be scattered by an electromagnetic field, their extended charge distribution will undergo a contact interaction with charged particles. The case of the neutral K meson (K^0) is considered as an example. The charge distribution arises from virtual dissociation into charged baryons. One contribution to the interaction is calculated. The interaction leads to a scattering of K^0's by charged particles. The form of this scattering is quite similar to that of the nuclear scattering of the K mesons, while its magnitude is much less, which implies that it will be difficult to detect. Possible other means of detecting the interaction are discussed. A.

539.12

2503. CHARGE-EXCHANGE SCATTERING OF K^0 BEAMS AS A TEST OF THE PARITY-DOUBLET PROPOSALS. H.P.Stapp.
Phys. Rev., Vol. 107, No. 2, 585-7 (July 15, 1957).

The determination of the $K_{s\pi}$ to $K_{s\pi}$ ratio in K^+ beams obtained from the charge-exchange scattering of a beam of neutral K-particles

should resolve the question of whether the K-particle is a parity doublet or a single particle. In the parity-doublet case the $K_{3\pi}$ to $K_{2\pi}$ ratio would, in general, depend upon the scattering angle and would differ from the value obtained in ordinary K^+ beams. The value of the ratio would depend upon, and give information concerning, the specific form of the interaction. If the K-particle is assumed to have zero spin, and if the strong interactions are charge-independent and are invariant under time reversal as well as space reflection and parity conjugation, then the $K_{3\pi}$ to $K_{2\pi}$ ratio in either the forward elastically scattered beam or in the backward elastically scattered beam must be four times its normal value. If there is a $\pi-K$ interaction among these strong interactions, then it is the forward direction in which the $K_{3\pi}$ to $K_{2\pi}$ ratio is four times normal. A.

539.12

2504. SCATTERING OF K^+ MESONS IN EMULSION.
G.Igo, D.G.Ravenhall, J.J.Tiemann, W.W.Chupp, G.Goldhaber, S.Goldhaber, J.E.Lunnutti and R.M.Thaler.
Phys. Rev., Vol. 109, No. 6, 2133-40 (March 15, 1958).

Some new experimental results on the scattering of K^+ mesons in emulsion are presented, in two energy ranges, $T_K = 40$ to 100 MeV and $T_K = 150 \pm 30$ MeV. An optical-model analysis is made of these results, which avoids many of the approximations of previous workers. It is concluded that the K^+—nucleus interaction is repulsive and that the K^+—nucleon cross-section inside the nucleus is compatible with the observed cross-section for free protons. A.

539.12

2505. MEASUREMENT OF THE TOTAL ABSORPTION COEFFICIENT OF LONG-LIVED NEUTRAL K PARTICLES.
W.K.H.Panofsky, V.L.Fitch, R.M.Motley and W.G.Chesnut.
Phys. Rev., Vol. 109, No. 4, 1353-7 (Feb. 15, 1958).

Long-lived neutral K particles were detected electronically and their total absorption cross-section in copper was measured in good geometry. The observed value of $\sigma = 1.12 \pm 0.25$ barns is compared with the corresponding values for charged-K-particle cross-sections. A.

539.12

2506. ON THE SPIN OF THE τ-MESON. G.I.Plebanskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 1, 65-8 (1958). In Russian.

The decay of the τ-meson (with each of the assignments 0^-, 2^+, 2^-) into three pions under the assumption of angular momentum and parity conservation is analysed by a method different from that of Dalitz. The calculations are carried out in the framework of first-order perturbation theory. The phenomenological interaction Lagrangian is determined by the requirement of Lorentz- and gauge-invariance and allowing only for first derivatives. For the case 2^+ this criterion is unique, for 0^- and 2^- the author restricts himself to the minimum number of derivatives. The calculated distributions are compared with those of Dalitz and with experimental evidence. It is found that for 0^- and 2^+ they are practically identical with Dalitz's results and conclusions. For 2^-, however, there is now also a possibility to match the experimental results, owing to the fact that in this case the interaction contains an arbitrary adjustable parameter. P.Roman

539.12

2507. A POSSIBILITY OF IDENTIFYING THE ANTIHYPERON $\bar{\Sigma}^-$ IN NUCLEAR EMULSIONS. N.I.Petukhova.
Zh. éksper. teor. Fiz., Vol. 33, No. 2(8), 553-4 (1957). In Russian.

From the known mass difference between Σ^+ and Σ^-, and thus between $\bar{\Sigma}^-$ and Σ^+, it follows that the π^+-meson from the decay $\bar{\Sigma}^- \rightarrow \bar{n} + \pi^+$ will have a different energy to that from $\Sigma^+ \rightarrow n + \pi^+$. W.O.Lock

539.12

2508. INTERNAL PAIR CREATION IN Σ^0 DECAY. G.Feinberg.
Phys. Rev., Vol. 109, No. 3, 1019-20 (Feb. 1, 1958).

It is pointed out that the probability of the alternative mode of decay of the Σ^0-particle, $\Sigma^0 \rightarrow \Lambda^0 + e^+ + e^-$, depends slightly on the assumed relative parities of the Σ^0 and Λ^0 particles, and is shown to be 12% greater for the case of equal parities. The distribution in a variable x, the length of the energy—momentum four-vector for the electron pair, is also given, but it has no greater dependence on the relative parities. S.J.Goldsack

539.12

2509. CALCULATION OF THE ANOMALOUS MAGNETIC MOMENTS OF THE Λ^0 AND THE Σ^0, Σ^+, Σ^- HYPERONS.
M.Nauenberg.
Phys. Rev., Vol. 109, No. 6, 2177 (March 15, 1958).

A field-theoretic perturbation calculation of hyperon anomalous magnetic moments due to K-mesons is made under the assumption that the coupling constant is small. The effect of baryon and strangeness conservation is to suppress some of the Feynman diagrams that appear in the analogous calculation of nucleon anomalous magnetic moments due to π-mesons, and leads to the relation between the anomalous magnetic moments of the Σ hyperons found by Marshak, Okubo and Sudarshan. A.

539.12

2510. RELATIONS BETWEEN THE HYPERON POLARIZATIONS IN ASSOCIATED PRODUCTION. R.Gatto.
Phys. Rev., Vol. 109, No. 2, 610-11 (Jan. 15, 1958).

Some restrictions imposed by symmetry requirements are discussed. G.H.Burkhardt

539.12

2511. V-PARTICLE PRODUCTION BY 1.9 BeV π^- MESONS.
G.G.Slaughter, E.M.Harth and M.M.Block.
Phys. Rev., Vol. 109, No. 6, 2111-16 (March 15, 1958).

A 20 atm hydrogen-filled diffusion cloud-chamber located in a magnetic field of 10 500 gauss was exposed to a beam of 1.9 BeV π^- mesons from the Brookhaven Cosmotron. Out of 20 000 pictures taken of the chamber there are two examples of V-particle production in the gas of the chamber, and 78 examples of decays of V particles which were presumably produced in the stainless steel walls of the chamber. One of the production events in the gas of the chamber is best interpreted as $\pi^- + p \rightarrow \Lambda^0 + K^0 + \pi^0$, while the other is an example of $\pi^- + p \rightarrow \Sigma^- + K^+$. The 63 neutral decays observed include 28 identified Λ^0 particles and 11 identified θ^0 particles. Momentum and angular distributions for the Λ^0 and θ^0 particles were obtained. Six of the V^0 decays, or about 10%, were classified as anomalous. Of these, three seemed to represent the β decay of neutral V particles into $\pi^\pm + e^\pm + \nu$. From the data on neutral V-particle decays the mean lifetime of the θ_2^0 was qualitatively measured as being probably between 10^{-9} and 10^{-8} sec. The cross-section for V-particle production by 1.9 BeV π^- mesons on protons is estimated to be ~ 1 mb. Some evidence was found which suggests the existence of a heavy cascade K-meson which decays into a conventional K-meson and a pion. A.

539.12

2512. ANGULAR CORRELATION FOR PRODUCTION AND DECAY OF Λ^0. D.Baroncini and V.De Sabbata.
Nuovo Cimento, Vol. 7, No. 5, 661-76 (March 1, 1958).

The angular correlation function for production and decay of the Λ^0 particles is obtained assuming spin $S = \frac{1}{2}$ for the Λ^0 and zero spin for the θ^0. Parity conservation and parity non-conservation in decay are discussed under the alternative hypothesis of either a definite parity for the $\Lambda^0-\theta^0$ system or of parity doublets. Parity non-conservation in decay leads to anisotropy with respect to the direction perpendicular to the plane of production. This anisotropy does not appear if parity is conserved. In either case the existence of parity doublets shows an anisotropic distribution in the plane of production, which involves odd powers of $\cos\theta$ (θ being the angle between the outgoing π^- and the Λ^0). If no parity doublets are assumed in production the angular distribution for the decay angle θ is in even powers of $\cos\theta$. Since the highest powers of $\cos\theta$ are determined by the value of the spin S of the Λ^0 particle, the angular distribution for decay can be indicative for the value S. Comparison is made with the experimental curves obtained in Bologna. A.

539.12

2513. ASSOCIATED PRODUCTION OF Σ^0 AND θ_2^0; MASS OF THE Σ^0. F.Eisler, R.Plano, N.Samios, J.Steinberger and M.Schwartz.
Phys. Rev., Vol. 110, No. 1, 226-7 (April 1, 1958).

An event in which θ_2^0 and Σ^0 production and decay are both observed, is described. This event yields a mass value for the Σ^0 and demonstrates the associated production of the θ_2^0. Additional events yielding mass values of the Σ^0 are reported. A.

539.12

2514. POLARIZED PROTONS FROM THE ELASTIC SCATTERING OF α-PARTICLES BY HYDROGEN. L.Rosen and J.E.Brolley,Jr.
Phys. Rev., Vol. 107, No. 5, 1454-5 (Sept. 1, 1957).

Recent calculations by Gammel and Thaler have indicated that the spin—orbit forces in Li^5 are likely to result in a high degree of polarization of protons elastically scattered from α-particles at energies at least up to 10 MeV. The variation of polarization with angle of scattering has been measured in detail using the protons knocked-on at 25° by α-particles of 25 MeV. These protons of 10 MeV were then scattered off 4 atmospheres of He gas and the left—right asymmetries measured using the photographic-plate technique to detect the scattered particles. The efficiency of He^4

as a polarizer–analyser has thus been established. The maximum polarization obtained was 99^{+1}_{-2}% at 121 ± 9° in the c.m. system and it was found to vary very strongly with angle. D.J.A.Prowse

NUCLEUS

539.14

2515. PROPERTIES OF NUCLEAR MATTER.
K.A.Brueckner and J.L.Gammel.
Phys. Rev., Vol. 109, No. 4, 1023-39 (Feb. 15, 1958).

The properties of nuclear matter have been determined by the solution of the nuclear many-body problem, using the reaction matrix theory of Brueckner. The nonlinear integral equations characteristic of the theory were solved with the aid of the fast electronic computer I.B.M. 704. The two-body interaction assumed is the phenomenological potential of Gammel, Christian, and Thaler. It is found that the binding energy of nuclear matter, neglecting Coulomb forces, is 14.6 MeV per particle at a density corresponding to a radius parameter $r_0 = 1.00 \times 10^{-13}$ cm. The Coulomb repulsion in a heavy nucleus is shown to drop the density by approximately 15%. The tensor force is shown to give approximately 6 MeV binding energy. The results are found to be very sensitive to the self-consistency requirements of the theory, the binding energy shifting from 14.6 MeV to 34.4 MeV if the velocity dependence of the single-particle potential is neglected. The actual solutions were made self-consistent by an iteration procedure which converged in five or six iterations, the final results being self-consistent to one part in 10^5 or 10^6. The effective mass for nucleon motion in the Fermi sea is found to vary from 0.56M for slow particles to 0.66M for particles near the Fermi surface. This velocity dependence of the potential is closely related to the symmetry energy which also depends, however, on the shifting in the spin populations as the neutron–proton ratio is changed from unity. The symmetry energy computed is 10 to 15% larger than that deduced from experiment. A.

539.14

2516. AXIAL SYMMETRY OF NUCLEAR WAVE FUNCTIONS.
R.K.Nesbet.
Phys. Rev., Vol. 109, No. 3, 1017-18 (Feb. 1, 1958).

The following result is formulated as a theorem: If, in the j–j coupling model of a nucleus, one has to deal with an unfilled shell, the Hartree–Fock solution must be of a lower symmetry than full spherical symmetry, but can always be made to have an axial symmetry. The relevance of this to the Bohr–Mottelson theory of the spheroidal nucleus is indicated. J.Lascoux

539.14

2517. CENTER-OF-MASS MOTION IN BRUECKNER THEORY FOR A FINITE NUCLEUS. H.J.Lipkin.
Phys. Rev., Vol. 109, No. 6, 2071-2 (March 15, 1958).

Centre-of-mass motion, generally not considered in the Brueckner theory, can cause divergences in the case of a finite nucleus. A possible way of avoiding this difficulty is presented. A.

539.14 : 539.17

2518. MODEL OF A SEMI-TRANSPARENT NUCLEUS WITH A DIFFUSE BOUNDARY. II. P.É.Nemirovskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1143-9 (1957). In Russian.

For Pt I see Abstr. 6916 (1956). A new method is proposed for calculation of the cross-sections for interaction between low-energy neutrons and nuclei. It is shown that at low energies the energy dependence of the cross-section for a potential with a diffuse boundary is the same as that for a rectangular well (absorption in the region of the boundary is assumed to be absent). The absorption cross-section in this case is larger than that of a rectangular well. The values of the parameters of the nuclear potential which yield satisfactory agreement with experiment in a large range of atomic weights and energies were determined. A.

539.14 : 539.17

DIRECT INTERACTION THEORY OF INELASTIC SCATTERING. See Abstr. 1945-6

539.14 : 530.145

BRUECKNER'S THEORY AND THE METHOD OF SUPERPOSITION AND CONFIGURATIONS. See Abstr. 2160

539.14

2519. ON THE BINDING ENERGY OF THE ^{16}O NUCLEUS.
J.Dabrowski.
Proc. Phys. Soc., Vol. 71, Pt 4, 658-67 (April, 1958).

A variational calculation of the binding energy of the O^{16} nucleus is presented. A two-body central Yukawa interaction with a hard core of radius a, and with Serber exchange is assumed and the parameters adjusted to fit the low-energy data. A two-parameter trial function in the form of a product of harmonic oscillator shell model wave-functions and correlation functions is assumed, and the Ursell–Jastrow cluster development is applied. The results show that the assumed two-body interaction with $0.2 < a < 0.6$ is capable of producing the saturation of both binding and density of the O^{16} nucleus. A.

539.14

2520. GYROMAGNETIC RATIO OF THE 10^{-8}-SEC STATE OF Ta^{181}. V.E.Krohn and S.Raboy.
Phys. Rev., Vol. 107, No. 2, 536-8 (July 15, 1957).

The gyromagnetic ratio of the 482 keV state of Ta^{181}(10^{-8} sec) was measured by angular correlation techniques and found to be + 1.23 ± 0.05 nuclear units. A.

539.14

2521. NUCLEAR POLARIZATION BY THE OVERHAUSER EFFECT IN SOLUTIONS OF PARAMAGNETIC IONS.
A.Abragam, J.Combrisson and I.Solomon.
C.R. Acad. Sci. (Paris), Vol. 245, No. 2, 157-60 (July 8, 1957). In French.

A discussion of the change of nuclear resonance signal when one hyperfine line of the electron resonance of a free radical is saturated. Especially with low fields when the hyperfine splitting is much larger than the unsplit electron resonance frequency, the nuclear alignment is much enhanced and negative leading to large nuclear resonance signals and in favourable cases to maser amplifiers and oscillators. With aqueous potassium peroxylamine disulphonate, proton resonance signals at 1948.5 Mc/s were observed with a signal to noise ratio of 100 : 1 using a 100 cm^3 sample in the earth's magnetic field by this means. By adding some positive reaction a stable auto-oscillator was obtained. Experiments at 3000 gauss were also used to check details of the theory and to demonstrate the change of sign of the nuclear polarization with increasing saturation of the electron resonance. D.H.Whiffen

539.14 : 532.7

2522. THE OVERHAUSER EFFECT IN LIQUIDS. J.Seiden.
C.R. Acad. Sci. (Paris), Vol. 245, No. 18, 1528-31 (Oct. 28, 1957). In French.

An expression is developed for the Overhauser effect in a liquid to show the dependence on viscosity. The formula shows that the nuclear polarization decreases rapidly as the viscosity increases. D.J.Oliver

539.14

2523. SPIN TEMPERATURE. A.Abragam and W.G.Proctor.
Phys. Rev., Vol. 109, No. 5, 1441-58 (March 1, 1958).

The introduction of the concept of spin-temperature into the literature has not been adequately supported by theory and experiment, and it has not been clear when the concept is essential, merely convenient, or possibly inapplicable. In fields high compared to a defined "local field" and where the individual energy levels are equidistant, it is argued that spin temperature is a convenient but unnecessary notion. Where the levels are not equidistant a spin temperature cannot generally be defined. Experiments are cited or described which demonstrate the rapid establishment of a Boltzmann population ratio when three or more levels are equidistant. It is for low fields, those which are comparable with the local field, that a theoretical examination making use of thermodynamic principles yields new quantitative predictions. In particular, a spin temperature is analytically defined, and its identity with thermodynamic temperature is experimentally established. Studies in "spin calorimetry", or the thermal mixing of two or more spin systems, strengthen the validity of the concept. A.

539.14

2524. ON MODULATING EFFECTS IN NUCLEAR MAGNETIC RESONANCE. K.V.Vladimirskiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 2(8), 529-30 (1957). In Russian.

539.14 : 539.1.07

NUCLEAR PARAMAGNETIC RESONANCE IN VERY LOW FIELDS. See Abstr. 2453

539.14

2525. RADIO-FREQUENCY ORIENTATION OF As^{76}.
F.M.Pipkin and J.W.Culvahouse.
Phys. Rev., Vol. 109, No. 5, 1423-39 (March 1, 1958).

Measurements are reported on the successful orientation of 26 hr As^{76} donors in a doped silicon crystal. A general discussion

is given of the various methods of dynamic nuclear orientation and how they apply to As^{76}. The use of radiofrequency orientation to determine the sign of the nuclear magnetic moment and the mixture of total angular momenta carried off by the electron–neutrino system is discussed. As^{76} was oriented by both saturation of forbidden transitions and double resonance methods. The hyperfine splitting of As^{75} in the doped silicon crystal is +198.42 ± 0.04 Mc/s; the hyperfine splitting of As^{76} in the same crystal is −93.660 ± 0.06 Mc/s. The spin of As^{76} is shown to be 2; its gyromagnetic ratio, −0.4514. The determination of the relative amounts of angular momenta carried off by the $2^- \rightarrow 2^+$, 2.41 MeV beta-ray gives a result which is consistent with 5 parts L = 0, 2 parts L = 1, and 3 parts L = 2. An unknown systematic error in these last measurements makes it difficult to say precisely what the mixture is. Unsuccessful attempts to produce orientation through the Overhauser and Abragam methods are summarized. A.

539.14 : 539.17

2526. MEASUREMENTS OF THE PROTON STRENGTH FUNCTION.
J.P.Schiffer, L.L.Lee, Jr, R.H.Davis and F.W.Prosser, Jr.
Phys. Rev., Vol. 107, No. 2, 547-9 (July 15, 1957).

The thick-target yield of gamma-rays from the (p,p'γ) reaction has been used to calculate values of the strength function $\langle\gamma^2\rangle_{Av}/\bar{D}$, of states in the compound nucleus for the channel of s-wave inelastic protons. Measurements of inelastic scattering to the 2+ first excited states of nine even-even nuclides, ranging from Ca^{44} to Zn^{64}, indicate a constant value for $\langle\gamma^2\rangle_{Av}/\bar{D}$ of 2.7×10^{-14} cm, within experimental error. This may be compared with the resonance in neutron strength function near atomic weight 55, as found in neutron elastic scattering. A.

539.14 : 539.17

2527. PROTON STRENGTH FUNCTIONS FROM (p,n) REACTION CROSS SECTIONS. J.P.Schiffer and L.L.Lee, Jr.
Phys. Rev., Vol. 109, No. 6, 2098-104 (March 15, 1958).

The (p,n) reaction cross-section was measured for thick targets of thirty-one elements ranging in atomic weight from 37 to 133 with incident proton energies between 2.0 and 4.0 MeV. The reaction yields were divided by a penetrability factor to yield a "reduced cross-section" closely related to the proton strength function. Peaks in the reduced cross-section were observed at atomic weight 50 and 68. These were tentatively identified as the peaks in the D-wave and S-wave strength functions of the complex-potential model corresponding to effects observed in neutron experiments at atomic weights 40 and 51. Assuming these identifications, the difference between proton and neutron potentials was calculated. Within the validity of the assumptions, Vr_0^2 for nuclei in the vicinity of atomic weight 70, was found after Coulomb corrections to be 6 ± 6% larger for protons than for neutrons. The reduced cross-section was observed to double in going from atomic weight 37 to 133, possibly because of the effect of spheroidal deformation on the barrier penetrability. Angular distribution measurements showed symmetry about 90° to better than 5%, indicating no measurable direct-interaction component in the reaction. The largest anisotropies observed were approximately 20%. A.

539.14 : 539.17

2528. STRENGTH FUNCTION DETERMINATIONS USING FAST NEUTRONS. F.Boreli and S.E.Darden.
Phys. Rev., Vol. 109, No. 6, 2079-82 (March 15, 1958).

Using the Li^7(p,n)Be^7 reaction as a source of neutrons, strength function determinations were made on a number of intermediate and heavy elements at average neutron energies between 65 keV and 360 keV. The strength functions $\langle\gamma_l^2\rangle_{Av}/\bar{D}$ are obtained from measurements of the deviation from exponential attenuation of the neutrons passing through a sample of the element being studied. Values of $\langle\gamma_0^2\rangle_{Av}/\bar{D}$ at lower energies exhibit qualitatively the dependence on atomic weight predicted by the optical model, in agreement with previous measurements. For elements in the region A = 90, the rapid increase with energy of the $\langle\gamma_0^2\rangle_{Av}/\bar{D}$ obtained assuming only S-wave interactions suggests appreciable P-wave interactions are taking place. The data for these elements have been analysed to yield $\langle\gamma_l^2\rangle_{Av}/\bar{D}$. A.

539.14 : 539.166.83

2529. EXCITED LEVELS IN Bi^{208} FROM THE DECAY OF Po^{208}. E.Arbman.
Nuclear Physics, Vol. 3, No. 5, 625-43 (July, 1957).

The energies and intensities of conversion electrons from the decay of Po^{208} have been studied in a double focusing beta-spectrometer. Relative gamma-intensities were measured in a scintillation spectrometer. Coincidences between pairs of conversion lines were studied in a coincidence spectrometer. No positrons were observed. A decay scheme is proposed, which contains 9 excited levels and includes 20 of the observed transitions. A.

539.14

2530. LEVELS IN Bi^{208}. S.Wahlborn.
Nuclear Physics, Vol. 3, No. 5, 644-8 (July, 1957).

A theoretical investigation has been made of energy levels in Bi^{208} following the same principles as used by Pryce (Abstr. 374/1953, 11318/1954, 6438/1957). Recent experimental results for the decay scheme of Bi^{208} have been interpreted according to the theoretical results. A.

539.14 : 539.166

2531. THE COULOMB EXCITATION OF Eu^{151} AND Eu^{153}. C.M.Class and U.Meyer-Berkhout.
Nuclear Physics, Vol. 3, No. 5, 656-69 (July, 1957).

The low-lying states of Eu^{151} and Eu^{153} to which transitions occur by means of Coulomb excitation have been studied by observing the spectra of the internal conversion electrons. Thin targets prepared from isotopically enriched europium oxide were bombarded with protons and alpha-particles in the energy range between 2 and 4 MeV. The measurements on Eu^{153} confirmed the existence of the previously reported rotational levels at 83 and 190 keV and yield improved values of the reduced transition probabilities. The transitions observed in Eu^{151} were found to fit conveniently into a level spectrum having states at 20, 193, and 304 keV. The first of these levels is known also from the beta-decay of Sm^{151}. The 304 keV level decays principally by an M1 transition to the ground state with relatively weaker transitions to the 193 and 20 keV levels. The 193 keV level undergoes transitions to the ground state only, by predominantly E2 radiation. The values of $B(E2)/e^2$ for excitation of the 193 and 304 keV levels were found to be 0.14×10^{-48} cm^4 and 0.40×10^{-48} cm^4, respectively. A.

539.14

2532. THE LOW-LYING ENERGY LEVELS OF ^{151}Eu.
A.Bisi, E.Germagnoli and L.Zappa.
Nuclear Physics, Vol. 3, No. 5, 670-8 (July, 1957).

The radioactive decay of Gd^{151} has been investigated. Measurements of electron conversion and γ-spectrum show the existence of γ-rays accompanying the electron-capture process. The energies of the γ-rays were found to be 21.3, 80. (144), 155, 176, 240, 299 keV. A decay shceme is proposed. A.

539.14 : 539.17

2533. X-RAY PHOTOEXCITATION OF Li^7.
O.Beckman and R.Sandström.
Nuclear Physics, Vol. 5, No. 4, 595-602 (March, 1958).

The level width and lifetime of the 477 keV level in Li^7 have been measured by photoexcitation using the continuous radiation from an X-ray tube. The level width has been calculated from an absolute measurement of the scattered radiation in an angle of 120 degrees and from a self-absorption experiment. The measured level width is $\Gamma = 6.2 \times 10^{-3}$ eV giving the lifetime $\tau = (1.1 \pm 0.3) \times \times 10^{-13}$ sec. The result is in agreement with earlier measurements by means of the Doppler broadening of the gamma-line following the reaction B^{10} (n,α)Li^7. A.

539.14

2534. PRECISION DETERMINATION OF SOME ENERGY LEVELS IN Fe^{57}, Zn^{67}, AND Tc^{99}.
E.L.Chupp, J.W.M.DuMond, F.J.Gordon, R.C.Jopson and H.Mark.
Phys. Rev., Vol. 109, No. 6, 2036-40 (March 15, 1958).

The 7.5 MeV deuteron beam of the A-48 linear accelerator was used to produce strong sources of the radioactive nuclides Co^{57}, Ga^{67}, and Tc^{99} by means of the (d,n) and (d,p) reactions on Fe^{56}, Zn^{66}, and Mo^{98}. Co^{57} and Ga^{67} decay by K-capture to excited states at Fe^{57} and Zn^{67}. Tc^{99} is made by the reactions Mo^{98}(d,n)Tc^{99} and Mo^{98}(d,p)Mo^{99} in which Mo^{99} subsequently decays to Tc^{99} with a half-life of 67 hours. Appropriate sources containing these nuclides were exposed in the high-resolution bent quartz crystal spectrograph previously described and photographic spectra were obtained of the strongest nuclear gamma-rays emitted by these sources. The plates were calibrated with X-rays and gamma-rays of known wavelengths. The energies (in keV) of the various gamma-rays measured are: Fe^{57}, 122.05 ± 0.05 and 136.40 ± 0.06; Zn^{67}, 93.26 ± 0.04 and 184.46 ± 027; and Tc^{99}, 140.52 ± 0.16. The cascade gamma-ray between the two levels in Zn^{67} was also observed and its energy was determined as 91.22 ± 0.04 keV in good agreement with the difference (91.20 ± 0.27 keV) between the values quoted above for this isotope. A.

539.14 : 539.164

2535. EXCITATION OF ROTATIONAL STATES IN α-DECAY OF EVEN-EVEN NUCLEI. V.M.Strutinskii.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1412-20 (1957). In Russian.

The relative probability of excitation of rotational states in the α-decay of deformed even-even nuclei is computed. The deformation parameter of the nucleus is determined by comparison with the probability for transition to the 2_+ state. The values of the deformation parameter and relative probability of transition to a 4_+ rotational state obtained in this way are compared with the experimental data. A.

539.14

2536. ROTATIONAL BANDS IN EVEN-EVEN AXIALLY-SYMMETRIC NUCLEI. A.S.Davydov and A.A.Chaban.
Zh. éksper. teor. Fiz., Vol. 33, No. 2(8), 547-9 (1957). In Russian.

The work of Davydov and Filippov (Abstr. 1953/1958) is extended to the region $\delta > 1$. It is found for $\delta > 2.5$ that a band structure enters the rotational levels, in quantitative agreement with experiment. A phenomenological explanation in terms of vibrational states requires five parameters, as against two used here. G.H.Burkhardt

539.14 : 539.17

ENERGY LEVELS OF Ne^{22}. See Abstr. 1975

539.14 : 539.166.2 : 539.17

ENERGY-LEVEL TRANSITIONS IN VARIOUS NUCLEI ON NEUTRON CAPTURE. See Abstr. 1981

RADIOACTIVITY

539.163

2537. METASTABLE STATE OF Ge^{73}.
E.C.Campbell and F.Nelson.
Phys. Rev., Vol. 107, No. 2, 502-3 (July 15, 1957).

A new short-period isomeric activity, with a gamma-ray energy of 54 keV and a half-life of 0.53 ± 0.03 sec, was observed following thermal neutron absorption in Ge^{72}. The gamma-ray transition is shown to arise from a metastable state of Ge^{73} at 67.4 keV excitation energy, known from the decay of As^{73}, but not previously characterized as to half-life. Chemical separation of Ge^{73m} from As^{73} by a gas-sweeping technique was sufficiently rapid to allow decay measurements of the separated gas. The half-life so determined is within experimental error the same as that found in the neutron-produced activity. A.

539.163

2538. RADIOACTIVE Ge^{77} AND Ge^{77m}.
W.S.Lyon and J.S.Eldridge.
Phys. Rev., Vol. 107, No. 4, 1056-7 (Aug. 15, 1957).

Pile neutron activation cross-sections for production of Ge^{77} and Ge^{77m} were obtained. In addition, the half-lives of Ge^{77} and Ge^{77m} were measured as well as the γ/β^- branching in the beta decay of Ge^{77m}. A.

539.163

2539. RATIO OF L/K X-RAY INTENSITIES IN THALLIUM-204 DECAY. H.Schmied and R.W.Fink.
Phys. Rev., Vol. 107, No. 4, 1062-4 (Aug. 15, 1957).

The ratio of L and K X-rays of Hg, resulting from orbital-electron capture in high-specific-activity sources of 4-year Tl^{204}, was measured with a gas proportional counter and a NaI(Tl) scintillation spectrometer. The intensity ratio was found to be $L/K = 0.46 \pm 0.04$. If one accepts a value of 0.524 for the L/K electron capture ratio from the theoretical results of Brysk and Rose, the mean L-fluorescence yield of Hg becomes $\omega_L = 0.34 \pm 0.04$. A study was made of the possible effect of fluorescent X-ray excitation owing to the non-carrier-free nature of the source; among sources of equal radioactive strength, ranging in superficial density from 0.54 to 2.21 mg/cm^2 in inert thallium nitrate solids, no appreciable change in the X-ray intensities was detected. A.

539.163

2540. AVERAGE DECAY ENERGY OF TRITIUM.
D.P.Gregory and D.A.Landsman.
Phys. Rev., Vol. 109, No. 6, 2091 (March 15, 1958).

The heat output of tritium was determined by calorimetry. If one assumes a half-life of 12.26 years, the average beta energy is shown to be 5.57 ± 0.1 keV. This is considerably lower than the value previously reported, and an explanation of this discrepancy is offered. A.

539.163

2541. RADIOACTIVITY OF ^{176}Ta, ^{179}Ta AND ^{180}Ta.
J.H.Carver and W.Turchinetz.
Proc. Phys. Soc., Vol. 71, Pt 4, 618-26 (April, 1958).

The neutron deficient isotopes, Ta^{178}, Ta^{179} and radioactive Ta^{180} have been produced by photodisintegration of Ta^{181} and studied with scintillation spectrometers used singly and in coincidence. The identification of each isotope is based on a knowledge of the (γ,n) threshold and an appropriate choice of bremsstrahlung energies. Radioactive Ta^{178} is shown to comprise an isomeric doublet with half-lives 9.5 ± 0.1 min and 150 ± 10 min. The 9.5 min activity populates levels in Hf^{178} at 0, 91 and possibly 1480 keV, the first two by both electron capture and β^+-emission and the last by electron capture, while the 150 min activity decays by electron capture to a level of Hf^{178} at 1046 keV. A decay scheme is proposed based on the experimental results and the strong coupling collective model of Bohr and Mottelson. Evidence is presented to support the recent contention that Ta^{179} decays by electron capture to the ground state of Hf^{179}. The observed γ radiation from 8.15 hour Ta^{180} is in general agreement with the decay scheme of Brown et al. (Abstr. 491/1952) except that there is no evidence for gamma-radiation in the energy range 175-450 keV. A.

539.163.1

2542. THE MEAN LIFE OF THE EXCITED STATE IN FLUORINE 17 AT 500 keV.
P.Lehmann, A.Lévêque, T.Grjebine, J.L.Picou and R.Barloutaud.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2259-61 (Dec. 16, 1957). In French.

Coincidence measurements on the γ-radiation from the O^{16} (p,γ) reaction lead to a value of $(2.9 \pm 0.9) \times 10^{-10}$ sec for the lifetime of the $\frac{1}{2}^+$ state in F^{17}. This figure is compatible with the existence of weak coupling of the particle with the O^{16} core. M.A.Grace

539.164 : 539.17

2543. EXPERIMENTAL INVESTIGATIONS OF ALPHA-DECAY OF ELEMENTS OF MEDIUM ATOMIC NUMBER. Yu.A.Surkov.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 5, 904-6 (1957). In Russian.

Gives a brief description of investigation of α-decay of nuclides of N from 82 to 126, obtained by bombardment of Er, Yb and Hf by protons of 70 to 660 MeV in synchrocyclotron. The products were separated by a chromatographic method and the results for the products obtained with 660 MeV protons are given. A table of detected α-active nuclides gives mass numbers, α-energies and half-lives. Two new nuclides are suggested: Dy^{153}, α-energy 3.3.MeV, half-life ~ 10 years; $Hf^?$, α-energy 3.5 MeV, half-life ~ 10^4 years. J.M.Zarzycki

539.165

2544. THE β-SPECTRUM OF RaD. A STUDY OF THE DIRECT TRANSITION TO THE GROUND STATE OF RaE.
J.Tousset and A.Moussa.
C.R. Acad. Sci. (Paris), Vol. 245, No. 19, 1617-20 (Nov. 4, 1957). In French.

This was examined using a double-focusing β-spectrometer; separation of the RaD and RaE spectra was achieved by following the increase of RaE in a freshly separated source. The transition to the ground state of RaE has a maximum β-particle energy of 61 keV, and occurs in 19 ± 4% of disintegrations. A.O.Stanesby

539.165 : 539.166

2545. TIME-REVERSAL INVARIANCE AND BETA–GAMMA ANGULAR CORRELATION. M.Morita and R.S.Morita.
Phys. Rev., Vol. 107, No. 5, 1316-21 (Sept. 1, 1957).

The angular correlation functions between beta and gamma rays from oriented nuclei (with or without observing circular polarization) are given for use in testing the invariance of the beta interactions under time-reversal. If the beta interactions are non-invariant under time-reversal, the angular correlation functions have asymmetries, $W(\Theta,\theta,\varphi) \neq W(\Theta,\theta,-\varphi)$ and $W(\Theta,\theta,\varphi,P) \neq W(\Theta,\theta,-\varphi,P)$, where the axis of the nuclear orientation is chosen as the z-axis, and the beta and gamma rays are assumed to be emitted in the directions with polar angles Θ, $\Phi \equiv$ zero, and θ, φ, respectively. P indicates the circular polarization of the gamma rays, and $P = +1$ (-1) for left (right) circular polarization. These asymmetries are of the order of $(p/W)\,\mathrm{Im}(C_T{}^*C_S' + C_T'{}^*C_S - C_A{}^*C_V' - C_A'{}^*C_V)$. The angular correlation functions between beta and gamma rays from unoriented nuclei (with or without observing circular polarization) are also considered. However, they do not give a clear-cut experiment to test the invariance of the beta interactions under time-reversal. Another method to test time-reversal invariance is to measure the difference between the values of $\mathrm{Re}(C_i{}^*C_j)$ and $|C_i| \cdot |C_j|$, etc. This is discussed briefly. A.

539.165

2546. ELECTRON-CAPTURE DECAY OF GADOLINIUM-151. V.S.Shirley and J.O.Rasmussen.
Phys. Rev., Vol. 109, No. 6, 2092-7 (March 15, 1958).

The photon and conversion electron spectra following electron-capture decay of Gd^{151} were studied. Transitions of 21.59 (M1), 153.7, 175.0 (M2), 243.8 (E1), and 308.4 keV seen in these spectra and a very weak transition of 155 ± 5 keV seen in coincidence with the 153.7 keV transition were assigned to the decay of Gd^{151}. Relative photon, conversion-electron, and transition intensities were determined for some of the transitions, and coincidence measurements were made at resolving times of 4 and 40 microseconds. A level scheme is proposed for Eu^{151} including the levels populated by Coulomb excitation, β^- decay of Sm^{151}, and electron-capture decay of Gd^{151}. A.

539.165.2

2547. POLARIZATION OF ELECTRONS IN FORBIDDEN β-DECAY. G.E.Lee-Whiting.
Canad. J. Phys., Vol. 36, No. 2, 252-3 (Feb., 1958).

This is calculated for longitudinal polarization. J.C.Taylor

539.165.2

2548. ELECTRON POLARIZATION IN BETA PROCESSES. R.B.Curtis and R.R.Lewis.
Phys. Rev., Vol. 107, No. 2, 543-7 (July 15, 1957).

Experiments have confirmed the hypothesis of Lee and Yang that there exist terms in the beta interaction which destroy the invariance of the theory under space inversion and charge conjugation; the possibility of the lack of invariance under time reversal had not yet been tested conclusively. Further consequences of these additional interactions are investigated, limiting the discussion to experiments involving the detection of polarized electrons and gamma-rays from unpolarized nuclei. In particular, formulae are derived for the longitudinal polarization of electrons in beta decay, and for the correlation of the transverse polarization of electrons with the direction of a gamma-ray. Such experiments would lead to an independent verification of the violation of selection rules for parity and charge conjugation, and to a possible test of the invariance under time reversal. A.

539.165.2

2549. BETA DECAY AND THE CONSERVATION OF PARITY. L.C.Biedenharn and H.E.Rorschach.
Phys. Rev., Vol. 107, No. 4, 1075-6 (Aug. 15, 1957).

An interpretation of experiments on the conservation of parity is proposed, which, utilizing a zero-rest-mass neutrino and Yukawa's model for the beta decay, conserves C and P separately for the nucleons as well as conserving CP for the over-all beta interaction. A.

539.165.2

2550. FIRST-FORBIDDEN TRANSITIONS IN PARITY-NONCONSERVING BETA DECAY. M.Morita and R.S.Morita.
Phys. Rev., Vol. 109, No. 6, 2048-58 (March 15, 1958).

Previous work on beta–gamma directional correlations is extended to phenomena of nonconservation of parity in beta decay. The parameters, $b_{LL'}{}^{(n)}$, which express the beta-ray angular distributions, are given for first-forbidden transitions of a general interaction, S.T.P.V.A. (combination of scalar, tensor, pseudoscalar, vector, and axial vector), where no interferences are assumed between S.T.P. and V.A. All of the possible interferences among the six nuclear matrix elements, $\mathfrak{M}(\beta\sigma.r)$, $\mathfrak{M}(\beta\gamma_5)$, $\mathfrak{M}(\beta r)$, $\mathfrak{M}(\beta\alpha)$, $\mathfrak{M}(\beta\sigma\times r)$, and $\mathfrak{M}(B_{ij}\beta)$ for S.T.P. (and the corresponding matrix elements for V.A.) are taken into account. By using these $b_{LL'}{}^{(n)}$'s, it is easy to express the correction factor of beta spectra, the beta-ray angular distributions from oriented nuclei, and the angular correlations between beta-rays and circularly polarized gamma-rays from unoriented nuclei in double and triple cascade transitions. The experimental data on the beta decays of Sb^{124} and Au^{198} are analysed. A.

539.165.2

2551. HIGHER ORDER EFFECTS IN THE β DECAY OF P^{32}. I.Iben, Jr.
Phys. Rev., Vol. 109, No. 6, 2059-62 (March 15, 1958).

The assumption is made that the β-decay of P^{32} is Δl-forbidden. The effect of interferences between second forbidden matrix elements and the (Δl-reduced) allowed elements on the decay probability is presented. By using simple shell-model wave-functions, an order of magnitude estimate of nuclear matrix elements is obtained. The resulting deviation of the energy spectrum from the allowed shape compares favourably with the experimental points of Porter, Wagner, and Freedman. A.

539.165.2

2552. POLARIZATION OF ELECTRONS IN β-DECAY. A.I.Alikhanov, G.P.Eliseev, V.A.Lyubimov and B.V.Érshler.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1344-9 (1957). In Russian.

In connection with a reconsideration of the law of conservation of parity some experiments were carried out to detect the longitudinal polarization of electrons emitted in β-decay. It is found that the β-electrons are emitted with spins whose direction is opposite to that of their motion. The degree of longitudinal polarization is equal to v/c, where v is the electron velocity. A.

539.165.2

2553. POLARIZATION OF ELECTRONS EMITTED IN β-DECAY. A.I.Alikhanov, G.P.Eliseiev, V.A.Lubimov and B.V.Ershler.
Nuclear Physics, Vol. 5, No. 4, 588-94 (March, 1958).

In connection with a reconsideration of the law of conservation of parity some experiments were performed with the purpose of detecting longitudinal polarization of electrons emitted in β-decay. It was found that the spin of the emerging β-electrons is opposite to the direction of electron motion. The magnitude of the longitudinal polarization agrees with the theoretical value, v/c, v being the electron velocity. See also the preceding abstract. A.

539.165.2 : 530.145

THE LOCALITY OF THE β-INTERACTION. See Abstr. 2139

539.166

2554. ODD-PARITY ROTATIONAL BANDS IN EVEN-EVEN NUCLEI. F.S.Stephens, Jr, F.Asaro and I.Perlman.
Phys. Rev., Vol. 107, No. 4, 1091-4 (Aug. 15, 1957).

The low-intensity radiations accompanying the alpha-decay of Th^{230} and Th^{228} were studied with a scintillation and coincidence spectrometer. In addition, the alpha-particle spectrum of Th^{228} was examined using a magnetic spectrograph. New gamma-rays of 253 keV (8×10^{-4}%), 110 keV (1×10^{-4}%), 206 keV (5×10^{-6}%), 235 keV (5×10^{-6}%) were found associated with Th^{230} decay. A new gamma-ray of 205 keV (0.03%) was found in Th^{228} decay, and also a fifth alpha group populating a level 289 keV above the ground state was observed in an abundance of 0.03%. A new level at 416 keV in Ra^{226}, suggested by these data and the coincidence measurements, was interpreted as the 6+ member of the ground-state rotational band. The remaining new levels was assigned as 3– and 5– members of rotational bands based on the 1– states previously observed in both Ra^{226} and Ra^{224}. A.

539.166.07

2555. THE γ-RAY SCINTILLATION SPECTROMETER. D.H.Peirson and P.Iredale.
Brit. J. appl. Phys., Vol. 8, No. 10, 422 (Oct., 1957).

A number of refinements are described which improve the operation of a two-crystal scintillation spectrometer previously described by Peirson. The principle of this spectrometer was the subtraction of the Compton continuum produced in a sodium iodide crystal, by using a matched anthracene detector system. The refinements are: the improvement of the Compton matching by placing a lead absorber in front of the anthracene; thermostatic control of the crystals, since these have different pulse amplitude temperature coefficients; and the use of a channel-width proportional to pulse height for the single-channel pulse amplitude analyser. The advantages of the latter refinement are detailed. D.R.Chick

539.166.2 : 539.14 : 539.17

γ-RAYS EMITTED BY NUCLEI ON CAPTURE OF THERMAL NEUTRONS. See Abstr. 1981

539.166.83

2556. ON ANOMALOUS CONVERSION COEFFICIENTS OF DIPOLE TRANSITIONS. S.G.Nilsson and J.O.Rasmussen.
Nuclear Physics, Vol. 5, No. 4, 617-46 (March, 1958).

General aspects of the problem of anomalous nuclear-structure-dependent contributions to the internal-conversion process are considered in conjunction with highly retarded electric or magnetic dipole transitions. Formulae for an elementary theory of anomalous internal conversion for E1 transitions are given. Selection rules for the relevant nuclear matrix elements are given in the quantum numbers appropriate to spheroidally deformed nuclei ($K, N, n_z, \Lambda, \Sigma$). Similar selection-rules for M1 transitions are given on the basis of the anomalous operators previously derived by Church and Weneser. The experimental data on dipole conversion coefficients of retarded transitions for odd-mass spheroidal nuclei are surveyed. It is noted that where retardation is ascribable to K-forbiddeness (up to retardation from the single-proton rate by a factor of 10^9) no detectable anomalies are found, but where transitions are allowed

by K-selection rules detectable conversion-coefficient anomalies may generally be found at retardations greater than 10^5 to 10^6 and are not found at lesser retardation. There are some exceptions to this general rule, though. From the present meagre data the utility of selection rules in the asymptotic quantum numbers, N, n_Z, Λ and Σ, for anomalous-conversion matrix elements may be open to question, although their utility in qualitatively explaining retardation of the radiative transitions is very evident. The simple E1 theory is applied in an attempt to explain quantitatively the very anomalous 85 keV transition in Pa^{231}. Values of the two parameters in the simple theoretical expressions can be found to explain all three L-subshell conversion coefficients. The magnitude of one parameter, the nuclear matrix element $\langle r^3 Y_1 \rangle$, is consistent with estimates from the single-particle model. However, the magnitude required of the other parameter is such as to suggest that in the intranuclear process terms of higher order in the electromagnetic field than treated here may be of importance. A.

539.166.83 : 539.14

DECAY OF Po^{206}. See Abstr. 2529

NUCLEAR REACTIONS

539.17 : 539.12

2557. ANGULAR DISTRIBUTION IN REACTIONS INVOLVING THE FORMATION OF THREE LOW ENERGY PARTICLES, WITH APPLICATION TO τ^+ MESON DECAY. V.N.Gribov.
Nuclear Physics, Vol. 5, No. 4, 653-68 (March, 1958).

The effect of interaction in the final state on the angular distribution in reactions involving the formation of three low energy particles is considered. In the case of non-resonance interaction the angular distribution can be expressed in terms of scattering amplitudes of pairs of particles. It is shown how the meson–meson scattering amplitudes can be deduced from the angular distribution of the decay products of the $\tau^+ \to 2\pi^+ + \pi^-$, $\tau^+ \to 2\pi^0 + \pi^+$ reactions. Experimental data presently available are insufficient for determining these amplitudes. A.

539.17

2558. POLARIZATION IN STRIPPING REACTIONS.
H.C.Newns and M.Y.Refai.
Proc. Phys. Soc., Vol. 71, Pt 4, 627-32 (April, 1958).

Recent experimental results make a new discussion of the mechanism of this reaction necessary. A classical discussion is presented and the conclusions confirmed by quantum-mechanical calculations at rather low energies. The qualitative features of the reaction seem now to be understood. A.

539.17

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.17 : 517.6

CLASSICAL ORBITAL INTEGRALS IN COULOMB EXCITATION. See Abstr. 2090

539.17

2559. RADIATIVE CAPTURE OF PROTONS IN CARBON FROM 80 TO 126 keV. W.A.S.Lamb and R.E.Hester.
Phys. Rev., Vol. 107, No. 2, 550-3 (July 15, 1957).

An excitation curve was obtained for the reaction $C^{12}(p,\gamma)N^{13}$ in the energy interval 80 to 126 keV, by utilizing beam currents of 30 to 50 mA from high-current ion injector. The capture-gamma radiation was measured with a 4 × 4 in. NaI scintillator, which was arranged to count only gamma radiation of the energy appropriate to the reaction. The yield per incident proton ranges from $(7.0 \pm 2.3) \times 10^{-18}$ at 80 keV to $(6.2 \pm 0.2) \times 10^{-16}$ at 126 keV, with corresponding cross-sections of $(1.4 \pm 0.4) \times 10^{-11}$ and $(6.8 \pm 0.8) \times 10^{-10}$ barns. A value for the cross-section of the reaction $C^{13}(p,\gamma)N^{14}$ was obtained at two energies: $(8.2 \pm 2.5) \times 10^{-9}$ barn at 126 keV, and $(5.1 \pm 2.0) \times 10^{-9}$ barn at 114 keV. The results are compared with previous measurements, and with extrapolations from the resonance in this reaction at 456 keV by means of the Breit–Wigner (1936) single-level dispersion formula. A.

539.17

2560. (p,p') AND (p,α) REACTIONS FROM K^{39}.
A.Sperduto and W.W.Buechner.
Phys. Rev., Vol. 109, No. 2, 462-4 (Jan. 15, 1958).

In the region of excitation up to 5.3 MeV, sixteen excited states in K^{39} were observed by means of inelastic scattering of protons from natural potassium. An electrostatic accelerator was used as a source of protons, the inelastically scattered protons were analysed at several angles with a magnetic spectrograph, and the incident beam energies were between 7 and 7.5 MeV. The first excited state in K^{39} is at 2.526 MeV. Two groups of alpha-particles from the reaction $K^{39}(p,\alpha)A^{36}$ were also observed. The Q-values for these groups are 1.286 ± 0.007 MeV and −0.691 ± 0.010 MeV, corresponding to the ground-state transition and to a level in A^{36} at 1.977 ± ± 0.008 MeV. A.

539.17

2561. (p,n) CROSS SECTIONS OF COPPER AND ZINC.
H.A.Howe.
Phys. Rev., Vol. 109, No. 6, 2083-5 (March 15, 1958).

The reaction cross-sections of Cu^{63}, Cu^{65}, Zn^{64}, Zn^{66}, and Zn^{68} were measured at energies up to 12 MeV. The energy dependence agrees with that predicted by the Shapiro calculations, but the large variation of cross-section among these nuclides suggests that interactions, other than compound nucleus formation, are taking place at these energies. The threshold of the reaction $Zn^{64}(p,n)Ga^{64}$ was determined, giving Q = −7.8 ± 0.15 MeV. A.

539.17 : 539.14

MEASUREMENTS OF THE PROTON STRENGTH FUNCTION. See Abstr. 2526-7

539.17 : 523.877

NUCLEAR REACTIONS WITH THE NEON ISOTOPES IN STARS. See Abstr. 2113

539.17

2562. NEUTRON YIELDS FROM THICK TARGETS BOMBARDED BY 18 AND 32 MeV PROTONS.
Yuin-Kwei Tai, G.P.Millburn, S.N.Kaplan and B.J.Moyer.
Phys. Rev., Vol. 109, No. 6, 2086-91 (March 15, 1958).

Neutron yields from thick targets bombarded by 32 and 18 MeV protons were measured for 59 elements and compounds. For 23 metallic elements, yields were also measured from targets thick enough to degrade the proton energy from 32 to 18 MeV. The neutrons were detected by counting the Mn^{56} activity produced by neutron capture in $MnSO_4$ solution contained in a 3 ft by 3 ft tank that surrounded the targets. The efficiency of the neutron-detection system was determined with a calibrated Ra-α-Be source. For all three energy intervals, the neutron yields increased abruptly at Z = 20 and Z = 30, and Ni had a yield $^1/_3$ that of neighbouring elements. The yields were compared with calculations based on the statistical theory of nuclear reactions. The agreement was fair for Z > 30, but the calculated yields did not reproduce the sudden jump at Z = 30. A.

539.17

2563. ON THE ANGULAR DISTRIBUTION OF DEUTERONS FROM THE $Be_4^9(p,d)Be_4^8$ REACTION. D.P.Grechukhin.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1460-3 (1957). In Russian.

It is shown that already at proton energies ≥ 8 MeV the main contribution is from the region within the Be^9 nucleus. This significantly modifies the deuteron angular distribution, good agreement with experiment being obtained for proton energies of ~ 22 MeV with a Be^8 radius $r_0 = 5 \times 10^{-13}$ cm. A.

539.17

2564. ANGULAR DISTRIBUTION OF PROTON GROUPS FROM THE REACTION $F^{19}(d,p)F^{20}$.
K.Ono, J.Shimada, K.Kuroda and S.Tanaka.
J. Phys. Soc. Japan, Vol. 12, No. 6, 745 (June, 1957).

The angular distributions of the protons leaving F^{20} in its ground state and first excited state at 650 keV were measured at a deuteron bombarding energy of 1.92 and 2.03 MeV using nuclear emulsion as a detector. That for the ground state is fairly isotropic, indicating that the reaction proceeds mainly through the compound nucleus formation. The excited state distribution is however strongly peaked at 60° indicating a transfer of $l_n = 2$. Particular attention was paid to the differential cross-section at zero degrees, as the exact value is important when assigning l-values to the captured neutron.

D.J.A.Prowse

539.17

2565. NUCLEON EXCHANGE EFFECTS IN THE $B^{10}(d,p)$ STRIPPING REACTION. N.T.S.Evans and A.P.French.
Phys. Rev., Vol. 109, No. 4, 1272-6 (Feb. 15, 1958).

The consequences of an exchange contribution to a specific stripping reaction are worked out in some detail. The particular transition considered is that which leads to the first excited state of B^{11} and which is forbidden by the angular momentum restrictions of ordinary stripping theory. The exchange calculation provides a

fair measure of agreement with experiment on the angular distribution, yield, and energy dependence of the reaction. The relation of the present analysis to treatments of heavy-particle and spin-flip stripping is briefly discussed. A.

539.17

2566. EXPERIMENTAL EVIDENCE FOR THE REACTION $d + T \rightarrow He^3 + n + n - 3$ MeV. J.E.Brolley, Jr, W.S.Hall, L.Rosen and L.Stewart.
Phys. Rev., Vol. 109, No. 4, 1277-9 (Feb. 15, 1958).

A continuum of doubly charged particles was observed from the interaction of 12 and 14 MeV deuterons with tritium. They are shown to arise from the $H^3(d,2n)He^3$ reaction. Absolute differential cross-sections are obtained. No evidence for the formation of a dineutron in a bound state, or in a well-defined virtual state, was found. A.

539.17

2567. ANGULAR DISTRIBUTIONS OF THE $B^{11}(d,n)C^{12*}$ FIRST EXCITED STATE NEUTRONS. O.Ames and G.E.Owen.
Phys. Rev., Vol. 109, No. 5, 1639-44 (March 1, 1958).

The angular distributions of the first excited state neutrons from the reaction $B^{11}(d,n)C^{12}$ were measured at deuteron bombarding energies of 0.6 and 1.0 MeV, using a single stilbene crystal counter. The distributions are asymmetric about the 90^0 direction, showing an excess in the forward direction. The data are consistent with an analysis based on nuclear stripping theory. Total cross-sections were obtained at 0.6, 0.8 and 1.0 MeV. A.

539.17 : 539.12

2568. NEUTRON YIELD FROM Rn + B, Rn + C, Rn + CaF_2, Rn + Mg, Rn + Al, Rn + Si, Rn + SiO_2, Rn + GRANITE SOURCES. G.V.Gorshkov and V.I.Matvienko.
Dokl. Akad. Nauk SSSR, Vol. 116, No. 2, 211-12 (1957). In Russian.

A study using boron detectors; the results are tabulated.

W.O.Lock

539.17

2569. REACTIONS $Al^{27}(\alpha,p)Si^{30}$ AND $P^{31}(\alpha,p)S^{34}$ AT 30.5 MeV. C.E.Hunting and N.S.Wall.
Phys. Rev., Vol. 108, No. 3, 901-3 (Nov. 1, 1957).

The experimentally observed differential cross-sections for the reactions $Al^{27}(\alpha,p)Si^{30}$ and $P^{31}(\alpha,p)S^{34}$ induced by 30.5 MeV α-particles are compared with those calculated on the basis of Butler's recent theory of direct nuclear reactions. For both reactions the experimentally observed forward peak is more pronounced than that predicted from Butler's theory and the secondary peaks are smaller but occurred in the correct angular positions. Closer agreement is obtained if Butler's original form factor is replaced by one of the type $\exp(-Q^2/Q_0^2)$ where Q is the linear momentum difference between the incoming and out going particles and Q_0 is an empirical parameter. The reaction mechanism can either be interpreted as a collision of the α-particle with a single proton in the nucleus leading to the ejection of the proton, or as a stripping reaction in which the α-particle is split into an absorbed triton and the observed proton, but both these mechanisms are incompatible with the concept of very short mean free paths for heavy particles in nuclear matter.

D.R.Chick

539.17

2570. THE MEAN FREE PATH OF ALPHA-PARTICLES IN NUCLEAR MATTER. B.A.Robson.
Proc. Phys. Soc., Vol. 71, Pt 1, 126-8 (Jan., 1958).

It is claimed that Porter's classical approximate analysis (Abstr. 9908/1955) of the elastic scattering of 20-40 MeV α-particles by complex nuclei contains an erroneous expression for the "transmission factor". This is corrected and the modified results are compared with some experimental data. If the diffuseness of the nuclear boundary and the α-particle mean free path near the nuclear centre are taken as freely-variable parameters, good agreement can be obtained. However, the best agreement values of these parameters are different from the values suggested by some optical-model analyses, so that the simple approach has doubtful validity.

D.R.Chick

539.17

2571. SOME PHOTONEUTRON THRESHOLDS.
B.G.Chidley, L.Katz and S.Kowalski.
Canad. J. Phys., Vol. 36, No. 4, 407-14 (April, 1958).

The photoneutron thresholds for a number of elements which have 100% abundance (or nearly so) in one stable isotope were measured. The following values in MeV were found:

Na (12.47 ± 0.05),	Al (12.98 ± 0.08),
Mn (10.14 ± 0.05),	Co (10.44 ± 0.05),
Nb (8.86 ± 0.05),	Rh (9.46 ± 0.08),
La (8.81 ± 0.05),	Pr (9.46 ± 0.05),
Tm (8.00 ± 0.05),	Ta (7.66 ± 0.05),
P (12.50 ± 0.05),	V (11.16 ± 0.05),
As (10.24 ± 0.05),	Y (11.82 ± 0.05),
I (9.14 ± 0.05),	Cs (9.11 ± 0.05),
Tb (8.16 ± 0.05),	Ho (8.10 ± 0.05),
Au (7.96 ± 0.07).	

A.

539.17

2572. PHOTONEUTRON THRESHOLD AND CROSS SECTION FOR $_{71}Lu^{175}$. H.J.King and L.Katz.
Canad. J. Phys., Vol. 36, No. 4, 415-18 (April, 1958).

The neutron yield resulting from photoneutron reactions in Lu^{175} was measured as a function of peak bremsstrahlung energy up to 23 MeV. The threshold energy for this reaction was found to be 7.77 ± 0.05 MeV. The giant resonance cross-section has a peak value of 225 millibarns at 16 MeV, a half-width of 8.4 MeV, and an integrated cross-section to 23 MeV of 1.9 MeV-barns. A.

539.17

2573. ON THE DETERMINATION OF THE NUCLEAR PAIR CORRELATION FUNCTION FROM THE HIGH ENERGY PHOTO-EFFECT. K.Gottfried.
Nuclear Physics, Vol. 5, No. 4, 557-87 (March, 1958).

In accordance with Levinger's predictions, the absorption of a high-energy photon (from a bremsstrahlung beam) frequently results in the simultaneous ejection of a neutron and proton. The present paper provides a theoretical analysis of this direct reaction, which starts from first principles and is based on the following assumptions: (i) the impulse and closure approximations are valid, (ii) the photo-nuclear interaction is a sum of two-nucleon operators, and (iii) the pair correlation function is given by $\rho_S(r_1,r_2)\,|g(r_1 - r_2)|^2$, where ρ_S is the shell-model correlation function and g(x) contains those correlations directly due to nuclear forces. The cross-section is then shown to be proportional to the probability for finding two nucleons with a certain total momentum in a relative S-state, the contributions from P-states being demonstrably small. The further assumptions required to relate the nuclear cross-section to the one for photodissociation of deuterium are examined, while final state interactions are treated with an optical model. The theory is compared with the present data and found to be in good agreement. The type of further information required for ascertaining the validity of assumptions (ii) and (iii) is discussed, and a method for acquiring it suggested. A.

539.17

2574. ELASTIC SCATTERING OF GAMMA-RAYS.
N.Cindro and K.Ilakovac.
Nuclear Physics, Vol. 5, No. 4, 647-52 (March, 1958).

Measurements of elastic scattering of 0.66, 1.12 and 1.33 MeV gamma-rays from medium and heavy nuclei, designed to investigate energy and Z dependence, are described and their results presented. A.

539.17

2575. ANGULAR DISTRIBUTION OF PHOTOPROTONS FROM DEUTERIUM FROM 9 TO 23 MeV. A.Whetstone and J.Halpern.
Phys. Rev., Vol. 109, No. 6, 2072-8 (March 15, 1958).

Photoprotons from a deuterated paraffin target irradiated with with betatron X-rays were detected with a NaI(Tl) scintillator. The angle and energy of the protons were measured, and the data fitted to the angular distribution form $f(\theta) = (A + B\sin^2\theta)(1 + 2\beta\cos\theta)$. The ratio A/B rises from a value of 0.015 ± 0.041 for the 9 to 12 MeV photon group to a value of 0.133 ± 0.020 for the 20 to 23 MeV group. A/B increases in a complicated way suggesting several contributions to the isotropic component. The value determined for β agrees with the calculation of v_p/c. A Schiff thin-target spectrum is assumed for the incident photons, and the cross-section obtained is consistent with the Marshall and Guth calculations, although the energy dependence of the data has slightly less slope than the calculated values. A.

539.17

2576. THE INTEGRATED CROSS SECTION FROM THRESHOLD TO 30 MeV FOR THE REACTION $^9Be(\gamma,2n)^7Be$. K.H.Lokan.
Proc. Phys. Soc. A, Vol. 70, Pt 11, 836-8 (Nov., 1957).

The $Be^9(\gamma,2n)Be^7$ reaction, whose calculated threshold is 20.56 MeV, was induced in a 1 in. wide beryllium cube by the bremsstrahlung beam from the 30 MeV Canberra Synchrotron. The

Be^7 was detected by the characteristic 477 keV γ-ray which decayed with the expected half-period. The bremsstrahlung flux was monitored by the activation of tantalum foils which were calibrated against the standard $Cu^{63}(\gamma,n)Cu^{62}$ process. After allowance for the γ-ray efficiency of the Be^7 counting system, the Be^7 yield per copper disintegration was obtained. From the known copper cross-section, the bremsstrahlung spectrum and a reasonable assumption for the excitation function of the reaction, the integrated cross-section up to 30 MeV was estimated as 1.2 ± 0.2 MeV millibarn, which is of the same order of magnitude as that previously obtained for the $He^4(\gamma,n)He^3$ reaction. D.R.Chick

539.17

2577. THE $(\gamma,2n)$ AND $(\gamma,3n)$ REACTIONS IN ^{181}Ta.
J.H.Carver and W.Turchinetz.
Proc. Phys. Soc., Vol. 71, Pt 4, 613-17 (April, 1958).

The $Ta^{181}(\gamma,3n)$ reaction has been studied by measuring the 9.5 min and 150 min activities of Ta^{178}. The two Ta^{178} isomers are produced in the effectively constant ratio A(9.5 min)/A(150 min) = = 3.0 ± 0.6 by gamma-rays of all energies between 24 MeV and 32 MeV. The experimental results have been combined with previous determinations of the $Ta^{181}(\gamma,n)$ cross-section and of the photo-neutron yield to obtain the relative cross-sections for the $Ta^{181}(\gamma,n)$, $(\gamma,2n)$ and $(\gamma,3n)$ reactions from their thresholds to 31 MeV. The integrated cross-sections for the (γ,n), $(\gamma,2n)$ and $(\gamma,3n)$ reactions to 31 MeV are (73 ± 3)%, (24 ± 3)% and (3.0 ± 1.2)% of the total integrated cross-section, (3.3 ± 1.2) MeV barns, for these three photo-neutron reactions. A.

539.17

2578. ANGULAR AND ENERGY DISTRIBUTIONS OF PROTONS PRODUCED IN THE PHOTODISINTEGRATION OF Be^9 AND C^{12}.
I.V.Chuvilo and V.G.Shevchenko.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1335-9 (1957). In Russian.

Results of measurements of the angular and energy distributions of protons produced in the photodisintegration of Be^9 and C^{12} are presented. The γ-ray source was a synchrotron with a maximum energy of 265 MeV. The protons were recorded by photographic plates. An analysis of the results leads to the conclusion that in the γ-ray region of 60-80 MeV, interaction of the γ-quanta proceeds predominantly on separate structures within the given nuclei. A.

539.17 : 539.14

X-RAY PHOTOEXCITATION OF Li^7. See Abstr. 2533

539.17 : 539.14

2579. THE 2.85 keV NEUTRON RESONANCE OF SODIUM.
J.E.Lynn, F.W.K.Firk and M.C.Moxon.
Nuclear Physics, Vol. 5, No. 4, 603-14 (March, 1958).

The measurement of the total neutron cross-section of sodium in the region 600 eV to 15 keV using the Harwell 15 MeV linear electron accelerator is described. Analysis of the results in conjunction with the known values of the low-energy elastic and radiative capture cross-sections leads to the following conclusions. The cross-section up to 15 keV may be described in terms of a potential scattering cross-section of 2.4 barn and two s-wave resonances, one at 2.85 ± 0.04 keV neutron energy and the other at negative energy. The 2.85 keV resonance has parameters σ_0 = 370 ± 5 barn, Γ_n = 405 ± 12 eV, $\Gamma_\gamma \leq 0.34 \pm 0.01$ eV and spin J = 1+. The negative energy resonance has a ratio of reduced width to resonance energy of $\gamma_n^2/E_R = -0.5$, while $|E_R| \gg 1$ keV. The spin of this resonance is J = 2+. A.

539.17

2580. THREE BODY BREAK UP. T.H.Berlin and G.E.Owen.
Nuclear Physics, Vol. 5, No. 4, 669-76 (March, 1958).

The continuous phase-space distribution function is evaluated for (n,2n) processes. The constraints of energy and momentum conservation are imposed in the form of delta functions. To facilitate transformation of the distribution function from the centre-of-mass coordinates to the laboratory coordinates, a general form of the Jacobian is developed. The $Be^9(n,2n)Be^8$ reaction is considered as an example. A.

539.17

2581. ON THE OPTICAL MODEL FOR NUCLEAR REACTIONS.
L.Verlet.
Nuovo Cimento, Vol. 7, No. 6, 821-8 (March 16, 1958).

The complex potential for neutrons in an infinite nuclear medium is computed in a perturbation calculation up to the second order, using for the nucleon–nucleon interaction a regular potential which fits the low energy two-body data. It is shown that it is possible to fit simultaneously the real and the imaginary part of the optical potential and the binding energy of the nuclear matter at normal density. Some arguments for the convergence of the theory are given. A.

539.17 : 539.14

2582. AN OPTICAL MODEL OF THE INTERACTION BETWEEN NUCLEONS AND NUCLEI IN THE RESONANCE REGION OF THE COMPOUND NUCLEUS. V.M.Agranovich and A.S.Davydov.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1429-36 (1957). In Russian.

The energy dependence of the real and imaginary parts of the effective potential of the optical model is investigated taking into account all the states of the compound nucleus. An interpretation is given of the broad resonances in the interaction between neutrons and nuclei. A.

539.17

2583. NEUTRON ACTIVATION CROSS SECTIONS WITH Sb–Be NEUTRONS. R.L.Macklin, N.H.Lazar and W.S.Lyon.
Phys. Rev., Vol. 107, No. 2, 504-8 (July 15, 1957).

The neutron activation cross-sections near 25 keV were measured for about 50 nuclei. Gamma-ray scintillation spectrometers with known efficiency were used to compare the radioactivities produced by the several nuclei with I^{128}. This gave a significant increase in sensitivity and precision over direct beta-counting methods in many cases. Absolute standardization was obtained through scintillation-beta-counting the I^{128} in NaI(Tl) crystals irradiated with a neutron source, the latter having been calibrated by the Mn bath technique. A.

539.17

2584. NEUTRON TOTAL CROSS SECTIONS OF CHROMIUM AND IRON IN THE keV REGION. C.T.Hibdon.
Phys. Rev., Vol. 108, No. 2, 414-21 (Oct. 15, 1957).

The neutron total cross-sections were measured in the energy range from 1 to 410 keV, using neutron energy spreads from about 0.3 to 0.7 keV. Variations in the cross-section of Cr show the presence of many resonances; seven of them in the region between 3 and 11 keV are due to neutron reactions with Cr^{53}, and many others at higher energies are attributable to Cr^{53} and other less abundant isotopes. Eleven resonances are due to s-wave neutron reactions with Cr^{52}. The results are similar for Fe. Fourteen, or possibly fifteen, resonances are due to s-wave neutron reactions with Fe^{56}. The values of the strength function of Cr^{52} and Fe^{56} for a well-depth of approximately 40 MeV are 1.3 and 1.5×10^{-4}, respectively, and for Cr^{53} it appears to be much higher. A new technique for analysis of s-wave neutron scattering resonances was developed. A.

539.17

2585. EXCITATION FUNCTION FOR $Fe^{56}(n,p)Mn^{56}$.
J.Terrell and D.M.Holm.
Phys. Rev., Vol. 109, No. 6, 2031-5 (March 15, 1958).

The relative cross-section for this reaction was measured by an activation method for neutron energies of 3.4 to 8.2 and 12.4 to 17.9 MeV, and normalized to the previously known value of 110 ± 10 mb at 14.3 MeV. The cross-section rises above the minimum detectable value of 0.2 mb at about 4.5 MeV, reaches a maximum of 116 mb at 13.5 MeV, and decreases to 62 mb at 17.9 MeV. The experimental results are compared with the predictions of statistical theory; the fit, although good in the vicinity of maximum yield, is poor at lower energies, the predicted yield being considerably too small. Cross-sections for $Fe^{54}(n,2n)Fe^{53}$ were also roughly determined at 16.9 and 17.9 MeV. A.

539.17

2586. INELASTIC NEUTRON SCATTERING BY U^{238}.
L.Cranberg and J.S.Levin.
Phys. Rev., Vol. 109, No. 6, 2063-70 (March 15, 1958).

Monoenergetic neutrons in the range 0.5 to 2 MeV were scattered from U^{238} and the spectra of scattered neutrons investigated by a time-of-flight method. Levels are located at 0.044 ± 0.004, 0.146 ± 0.006, 0.30 ± 0.03, 0.73 ± 0.02, 0.98 ± 0.02, 1.06 ± 0.03, and 1.26 ± 0.04 MeV. The cross-sections for excitation of these levels are obtained corresponding to inelastic neutron scattering at 90°. An angular distribution is obtained for the inelastically scattered neutrons corresponding to excitation of the 44 keV level by incident neutrons of 550 keV energy. This distribution is of the form $A(1-B\cos^2\theta)$ where A is 0.135 ± 0.02 barn per steradian and B is 0.45 ± 0.1. The cross-section is in good agreement with calculations by Chase and Wilets which indicate compound nucleus formation is the dominant mechanism in inelastic neutron scattering by U^{238} at 550 keV, although the anisotropy is larger than that predicted. A.

539.17

2587. ANGULAR DISTRIBUTIONS OF ELASTIC SCATTERING OF 5 MeV NEUTRONS. R.W.Hill.
Phys. Rev., Vol. 109, No. 6, 2105-10 (March 15, 1958).

The differential cross-sections for elastic scattering of 5 MeV neutrons from C, O, Al, Fe, Ni, Cu, Mo, Ba, W, and Pb were measured over an angular range between 30° and 150°. The experimental values are compared with the predictions of a diffuse-surface optical model. A.

539.17

2588. ELASTIC SCATTERING OF 350 MeV NEUTRONS BY COMPLEX NUCLEI. G.E.Brown, A.Ashmore and R.Nordhagen.
Proc. Phys. Soc., Vol. 71, Pt 4, 565-73 (April, 1958).

The scattering of 350 MeV neutrons by lead and carbon is analysed using the optical model. The parameters of the latter are determined as well as possible. The problem of the unambiguous determination of optical model parameters is considered in detail for the high-energy region. A.

539.17

2589. ON THE LOWEST LEVEL OF EXCITATION OF I^{127} BY THE INELASTIC SCATTERING OF D–D NEUTRONS.
H.Heymann, G.Lindström and H.Neuert.
Z. Naturforsch., Vol. 11a, No. 11, 919-20 (Nov., 1956). In German.

The γ-ray spectrum of I^{127} was examined following the inelastic scattering of D–D neutrons in a NaI (Tl) crystal used as a scintillator. Energy calibration of the pulse height analysis was provided by the I^{131} γ-ray line at 264 keV and by a radioactive preparation emitting Hg K-lines of 78 keV. The existence of a line at 65 keV was confirmed, in addition to one at 210 keV. The soft γ-rays play a major part in the operation of NaI scintillators as counters for medium-energy neutrons. D.J.A.Prowse

539.17 : 539.14

STRENGTH FUNCTION DETERMINATION USING FAST NEUTRONS. See Abstr. 2528

539.17

2590. SPHERICAL-HARMONICS METHOD FOR NEUTRON TRANSPORT THEORY PROBLEMS WITH INCOMPLETE SYMMETRY. B.Davison.
Canad. J. Phys., Vol. 36, No. 4, 462-75 (April, 1958).

Deals with the application of the spherical-harmonics method to neutron-transport problems in which the geometrical arrangement possesses spherical or cylindrical symmetry, but the distribution of sources and/or the conditions at infinity lack such symmetry. Certain classes of cases of this nature are considered, and for these, in an arbitrary-order approximation, the solution is given, in closed form, in terms of a finite number of Bessel functions. A.

539.17

2591. NUCLEAR INTERACTIONS OF HIGH-ENERGY μ MESONS IN CARBON. I.B.McDiarmid.
Phys. Rev., Vol. 109, No. 5, 1792-800 (March 1, 1958).

A multiplate cloud-chamber containing two large plastic scintillators capable of selecting nuclear interactions is described. Forty-three interactions, attributed to energetic μ-mesons, were observed in the chamber and the following cross-sections for interactions in carbon obtained: $(5.6 \pm 1.1) \times 10^{-30}$ cm^2/nucleon for all interactions involving energy transfers > 50 MeV and $(1.7 \times 0.6) \times 10^{-30}$ cm^2/nucleon for shower production. It is shown that several aspects of the interactions can be reasonably accounted for with the aid of the semi-classical Williams–Weizsäcker method and the results are used to infer photon interaction cross-sections in carbon for photon energies up to about 10 BeV. The μ-meson cross-sections reported are in agreement with those found by George and Evans using emulsion techniques, but some of the details of the interactions differ and it is suggested that an appreciable fraction of the stars observed in an emulsion exposed underground may be due to π-mesons or protons. A.

539.17

2592. ON THE CAPTURE OF POLARIZED μ^--MESONS BY NUCLEI. B.L.Ioffe.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 308-9 (1957). In Russian.

The asymmetry in the angular distribution of neutrons emitted in nuclear capture of polarized μ^--mesons is calculated using the two-component theory of the neutrino. It is shown that the value of the asymmetry constant in the case of μ^--meson capture by light nuclei will indicate the nature of the interaction between polarized μ^--mesons and nucleons (scalar, vector and pseudoscalar: $\beta = 1$; tensor and axial-vector $\beta \approx -\frac{1}{3}$). S.Chomet

539.17 : 539.12

INFLUENCE OF THE FOUR-FERMION INTERACTION ON THE MUON CAPTURE RATE. See Abstr. 2485

539.17

2593. THE THERMAL-NEUTRON FISSION CROSS SECTION OF Pu^{240}. C.B.Bigham.
Canad. J. Phys., Vol. 36, No. 4, 503-7 (April, 1958).

A measurement of the thermal-neutron fission cross-section of Pu^{240} is described. The value obtained, -0.8 ± 0.7 barns, is compared with other measurements. A.

539.17 : 523.877

2594. NUCLEAR REACTIONS IN STARS. BUILDUP FROM HELIUM. E.E.Salpeter.
Phys. Rev., Vol. 107, No. 2, 516-25 (July 15, 1957).

The rates are calculated for thermonuclear reactions involving alpha-particles, at temperature T of the order of 10^8 °K. In particular, the conversion of three alpha-particles into a C^{12} nucleus and (α,γ) reactions on C^{12}, O^{16}, and Ne^{20} are considered as well as $C^{13}(\alpha,n)O^{16}$. Rough estimates are also given for alpha reactions on the other isotopes of N, O, F, and Ne. The reaction rates are used to re-evaluate some characteristic central temperatures T_c for Hoyle and Schwarzschild's model for the evolution of a population II red giant: For stars "at the tip of the red-giant branch", where helium burning first becomes important, $T_c \cong 1.0 \times 10^8$ °K; for stars at the beginning of the "horizontal branch", where helium burning contributes appreciably to the energy production, $T_c \cong 1.3 \times 10^8$ °K. At these temperatures the rates of formation of C^{12}, O^{16}, and Ne^{20} are roughly comparable (if the spin and parity of a certain resonance level in Ne^{20} is suitable), but the production rate of Mg^{24} and heavier nuclei is negligible. Of the alpha reactions on the rarer isotopes, by far the fastest is $C^{13}(\alpha,n)$ and most of the C^{13} is used up near $T_c = 0.8 \times 10^8$ °K. A.

539.17

2595. THE CONVERGATRON, A NEUTRON AMPLIFIER. L.B.Borst.
Phys. Rev., Vol. 107, No. 3, 905-6 (Aug. 1, 1957).

By using a fissionable fuel zone, a thermal neutron barrier and a neutron moderator in series, a single stage neutron amplifier may be formed. The author claims that by using a small primary source and several stages, an inherently safe, arbitrarily large neutron source can be made. The results of a transport theory calculation by Michael for infinite slab geometry, are given in a table showing the percentage of critical fuel thickness for a given stage gain and moderator thickness, e.g. 12.5 cm of D_2O moderator and 5.90 cm of U^{235} give a stage gain of 10. Feedback effects are considered and the stability requirement stated. Equations governing the kinetic behaviour of a series array are stated. Controlled rate fuel circulation from output to input to provide a variable delayed neutron source is considered to make the system self-sustaining with unlimited delayed neutron control. No mention of either fission product poisoning or neutron leakage is made. T.O.Jeffries

539.17

2596. NEUTRON PRODUCTION IN LINEAR DEUTERIUM PINCHES. O.A.Anderson, W.R.Baker, S.A.Colgate, H.P.Furth, J.Ise, Jr, R.V.Pyle and R.E.Wright.
Phys. Rev., Vol. 109, No. 2, 612-13 (Jan. 15, 1958).

Measurements on neutron yield in straight, high-current discharges showed many features consistent with a thermonuclear process; but ranges of knock-on protons in photographic plates placed at the ends of the tube showed that the neutrons are produced in deuterium reactions with a pronounced centre-of-gravity motion towards the cathode, corresponding to 50 keV deuterons colliding with stationary ones. Cylindrically symmetrical instabilities may be responsible for this axial acceleration. In discharges partially stabilized by an axial magnetic field, a neutron yield correlated with the onset of helical instability was observed. R.S.Pease

539.17

2597. RECENT DEVELOPMENTS IN NUCLEAR INSTRUMENTATION AT THE KNOLLS ATOMIC POWER LABORATORY. R.S.Stone.
Trans Amer. Inst. Elect. Engrs I, Vol. 76, 396-9 (1957) = Commun. and Electronics, No. 32 (Sept., 1957).

A general description is given of the instrumentation of the critical assemblies and research reactor at the Knolls Atomic Power Laboratory. The safety circuits are detailed followed by a synopsis of the instrumentation installed for reactor and neutron physics experiments. T.O.Jeffries

539.17 : 537.525

PINCHED DISCHARGE AND THERMONUCLEAR REACTORS.
See Abstr. 2347

ATOMS

539.18 : 548.74

2598. NOTE ON THE ATOM FORM FACTOR.
J.Odziemczyk and T.Tietz.
Nuovo Cimento, Vol. 6, No. 6, 1491-3 (Dec., 1957).

Using Buchdahl's approximate solution for the Thomas–Fermi function, an analytic expression is obtained for the atom form factor F(Zk) as given by Thomas–Fermi theory, where Z is the atomic number, $k = (\sin\theta)/\lambda$, 2θ is the scattering angle and λ the Broglie wavelength of the incident electron. F(Zk), calculated for Cs (Z = 55) for various values of k, compares well with the numerical calculations of Bragg and West, and Umeda, differing from the latter's results by less than 3%. M.J.Kearsley

539.18

2599. NATURAL SHAPE OF ENERGY LEVELS.
B.I.Stepanov and P.A.Apanasevich.
Dokl. Akad. Nauk SSSR, Vol.115, No. 3, 488-90 (1957). In Russian.

The broadening of atomic energy levels, due to interaction with the radiation field, is calculated by a stationary-state formalism, and the result obtained is in agreement with that of Weisskopf and Wigner. P.K.Kabir

539.18 : 539.12

2600. THE EXCITATION OF THE 2p STATE OF HYDROGEN BY SLOW ELECTRONS — DISTORTED WAVE TREATMENT.
S.Khashaba and H.S.W.Massey.
Proc. Phys. Soc., Vol. 71, Pt 4, 574-84 (April, 1958).

The distorted-wave method was applied to the calculation of the cross-sections for excitation of the 2p-state of hydrogen by impact of electrons with energies between 13.5 and 54 eV. The polarization of impact radiation emitted from the 2p-state when excited by an electron beam was also calculated. Comparison of results obtained using the Born–Oppenheimer approximation shows that the effect of distortion on the total cross-section is not as great as for the excitation of the 2s-state. It is pointed out that coupling between the 2s- and 2p-states which has been neglected in all calculations may be important. A.

539.18 : 539.12

2601. THE EFFECT OF THE SIZE OF THE PROTON ON THE POSITION OF ELECTRON LEVELS IN HYDROGEN AND DEUTERIUM. N.N.Kolesnikov.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 819-21 (1957). In Russian.

The contribution, ΔE_H, to the Lamb shift due to the finite size of the proton is calculated to be $\Delta E_H = 0.117 \pm 0.03$ Mc/s, in agreement with a previous estimate (Dokl. Akad. Nauk SSSR, Vol. 91, 47, 1953). For the deuteron, the difference $\Delta E_D - \Delta E_H = 1.33 + \delta_n$ Mc/s, where δ_n is the correction for the finite size of the neutron. W.O.Lock

539.18 : 539.12

2602. EFFECT OF THE STRUCTURE OF THE PROTON ON THE LAMB SHIFT. É.V.Teodorovich.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9) 823-5 (1957). In Russian.

The contribution, ΔE_H, to the Lamb shift is calculated by the method of precise wave-functions to be $\Delta E_H = 0.117 \pm 0.03$ Mc/s.
See also preceding abstract. W.O.Lock

539.18 : 536.631

HYPERFINE COUPLING SPECIFIC HEAT IN COBALT METAL.
See Abstr. 2286

539.18

2603. INTERACTION ENERGY OF ATOMS AT SMALL NUCLEAR SEPARATIONS. O.B.Firsov.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1464-9 (1957). In Russian.

The Thomas–Fermi equation for electrons can be obtained from minimality of a certain functional of the spatial density distribution. Simultaneously a functional of a certain function of the coordinates is established whose maximum value is equal to the same energy of the electrons. It is shown for the case of two nuclei that if one inserts in the functionals the sums of the electron densities and functions, which respectively transform them into a minimum or maximum in the presence of a single nucleus, the relative difference of the functionals will not exceed 5%. The energy values of electrons lie between the values of these functionals. A.

MOLECULES

539.19

2604. ON THE COUPLING OF OSCILLATIONS OF THE COMPLEX IONS OR MOLECULES IN THE CRYSTALLINE MESH. H.Poulet.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2039-41 (Dec. 4, 1957). In French.

Calculation of the tensor of polarizability of a crystalline mesh by algebraic addition of the molecular tensors is claimed to give incorrect values of the absolute spectral intensities. G.I.W.Llewelyn

539.19 : 535.343

2605. MICROWAVE SPECTRUM AND BARRIER TO INTERNAL ROTATION OF ACETIC ACID. W.J.Tabor.
J. chem. Phys., Vol. 27, No. 4, 974-5 (Oct., 1957).

Reports measurements of the microwave spectra of CH_3COOH, and CD_3COOH, and the calculation therefrom of the molecular rotation constants, by the methods of the abstract that follows. The barrier obtained is 483 ± 25 cal/mole. J.Hawgood

539.19

2606. TABLES OF MATHIEU INTEGRALS FOR THE INTERNAL ROTATION PROBLEM. D.R.Herschbach.
J. chem. Phys., Vol. 27, No. 4, 975 (Oct., 1957).

Describes numerical tables of matrix elements and perturbation sums associated with periodic solutions of Mathieu's equation, needed in the treatment of internal rotation by the methods of Abstr. 8045, 8048 (1957). The tables extend to the eighth torsional level and to the fourth order perturbation. J.Hawgood

539.19 : 535.343

2607. MICROWAVE SPECTRUM AND BARRIER TO INTERNAL ROTATION FOR TRANS-FLUORO-PROPYLENE. S.Siegel.
J. chem. Phys., Vol. 27, No. 4, 989-90 (Oct., 1957).

This spectrum has been measured and analysed (see two preceding abstracts). The barrier obtained is 2200 ± 100 cal/mole. J.Hawgood

539.19

2608. TABLES OF COEFFICIENTS FOR THE ENERGY LEVELS OF A NEAR SYMMETRIC TOP. R.H.Schwendeman.
J. chem. Phys., Vol. 27, No. 4, 986 (Oct., 1957).

Describes an extension from J = 12 to J = 40 of a numerical table published in "Microwave Spectroscopy" by Townes and Schawlow (Abstr. 2772/1956). The coefficients tabulated are those in the expansion of the energy of a level in powers of the asymmetry parameter. J.Hawgood

539.19

2609. SUPERIORITY OF THE POESCHL–TELLER POTENTIAL TO THAT OF MORSE FOR DIATOMIC MOLECULES. C.L.Beckel.
J. chem. Phys., Vol. 27, No. 5, 998-1000 (Nov., 1957).

The accuracies of the Poeschl–Teller and Morse functions as vibrational potential energies are compared for the ground electronic states of sixty-seven diatomic molecules. For each molecule both functions are fitted to the experimental values of Y_{10}, Y_{20}, and Y_{01}. The comparison of the functions is then made through examination of $-Y_{11}$. For fifty-four of the molecules the P.T. function is more accurate than the Morse function. The superiority of the P.T. function seems more pronounced for ionized and for predominantly-ionic molecules than for normal covalent molecules. Parameters of Poeschl–Teller curves fitted to empirical values of Y_{10}, Y_{20}, Y_{01} and Y_{11} are tabulated for the sixty-seven molecules. A.

539.19

2610. COMPUTATION OF RIGID ASYMMETRIC ROTATOR CONSTANTS FROM ENERGY MOMENTS.
L.C.Brown and P.M.Parker.
J. chem. Phys., Vol. 27, No. 5, 1108-10 (Nov., 1957).

Expressions are developed which relate the rotational constants of the rigid asymmetric rotator to experimental data through moments of the energy levels. The procedure in many cases permits the computation of rotational constants with much less effort than is usually met in either numerical approximation to roots of secular equations or perturbation methods. A.

539.19

2611. INTERACTION OF VIBRATIONAL AND ELECTRONIC MOTION IN ALKALI HALIDE MOLECULES. R.S.Berry.
J. chem. Phys., Vol. 27, No. 6, 1288-95 (Dec., 1957).

A treatment is developed to interpret the observation that in

corresponding regions of the ultraviolet the absorption spectra of sodium iodide and potassium iodide show a band system and a continuum, respectively. The former results from a bound excited state in which the form of the electronic wave-function changes drastically with internuclear distance. The latter arises because the nuclear motion can no longer be considered adiabatic with respect to electronic motion, so that the noncrossing rule does not apply.

A.

539.19

2612. ROTATIONAL ANALYSIS OF BANDS OF THE $A^3\Pi_{0+}$, $B^3\Pi_1 - X^1\Sigma^+$ SYSTEMS OF THALLOUS FLUORIDE.
R.F.Barrow, H.F.K.Cheall, P.M.Thomas and P.B.Zeeman.
Proc. Phys. Soc., Vol. 71, Pt. 1, 128-30 (Jan., 1958).

Rotational and vibrational constants for the three states are given. The rotational constants for the ground state are in agreement with these derived from the microwave spectrum. The energy of dissociation found spectroscopically is $D_0'' = 109.5 \pm 0.6$ kcal, 5.4 kcal higher than the (less reliable) thermochemical value.

R.F.Barrow

539.19

2613. THE STRUCTURE OF THE $X^7\Sigma$ STATE OF MnH AND MnD.
W.Hayes, P.D.McCarvill and T.E.Nevin.
Proc. Phys. Soc. A, Vol. 70, Pt 12, 904-5 (Dec., 1957).

The results of analyses of the 0,2 bands of the $A^8\Pi - X^7\Sigma$ systems of MnH and MnD are used to derive improved constants for the ground state; thus

MnH	$\omega_e'' = 1548.0$ cm^{-1}	$x_e''\omega_e'' = 28.8$ cm^{-1}
MnD	1102.5	13.9

$r_e'' = 1.722$ A.

R.F.Barrow

539.19

2614. SPIN EXCHANGE IN A BIRADICAL.
D.C.Reitz and S.I.Weissman.
J. chem. Phys., Vol. 27, No. 4, 968 (Oct., 1957).

Electron spin resonance is observed in a biradical, 4-4' oxybistriphenylmethyl, where a considerable fraction of the C^{12} which interacts with the unpaired electron is replaced by C^{13}. The hyperfine structure spectrum depends upon whether the spin exchange between parts of the coupled systems is fast or slow compared with the hyperfine frequency. The observed spectrum indicates that the latter is the case, and that the exchange frequency is less than 10^8 sec^{-1}. J.M.Baker

539.19

2615. ELECTRON SPIN RESONANCE OF N^{15}-NITROBENZENE NEGATIVE ION. R.L.Ward and M.P.Klein.
J. chem. Phys., Vol. 28, No. 3, 518-19 (March, 1958).

The electron spin resonance hyperfine structure observed in a nitrobenzene negative ions is ascribed to unequal coupling between the unpaired electron and the nuclei of the nitrogen atoms and the meta, para and ortho hydrogen atoms. The interpretation of the hyperfine structure and the value of the nitrogen coupling constant is confirmed by replacing the N^{14} by a mixture of 64% N^{15} and 36% N^{14} and observing the new spectrum. J.M.Baker

539.19

2616. ON THE SPIN–ORBIT INTERACTION IN DIATOMIC MOLECULES. I. I.Kovács.
Canad. J. Phys., Vol. 36, No. 3, 309-28 (March, 1958).

The first part of the paper deals with perturbation between states of odd multiplicity in a two-electron system. With the aid of the matrix elements which have been obtained, a comparison of the perturbations in the various components of a given state and in some cases a comparison of perturbations in two different states is possible. Also for certain cases it has been possible to establish relationships between the matrix elements which give the magnitude of the perturbations and experimentally measurable molecular constants of the perturbed states. A.

539.19

2617. ON THE SPIN–ORBIT INTERACTION IN DIATOMIC MOLECULES. II. I.Kovács.
Canad. J. Phys., Vol. 36, No. 3, 329-51 (March, 1958).

Deals with perturbations between states of even multiplicity in a three-electron system. With the aid of the matrix elements which have been obtained, a comparison of the perturbations in the various components of a given state and in some cases a comparison in two different states is possible. Also for certain cases it was possible to establish relationships between the matrix elements which give the magnitude of the perturbations and experimentally measurable molecular constants of the perturbed states. A.

539.19

2618. NEGATIVE SPIN DENSITIES IN AROMATIC RADICALS.
H.M.McConnell and D.B.Chesnut.
J. chem. Phys., Vol. 27, No. 4, 984-5 (Oct., 1957).

The semi-empirical linear relation between proton coupling coefficient and "odd electron density" ρ_j in an aromatic radical (Abstr. 3892, 5234/1956) has been found not to apply to triphenylmethyl and perinaphthenyl (Abstr. 8057/1957). A suitable generalization of the definition of ρ_j, which allows negative values, enables the linear relation to be applied to these radicals. J.Hawgood

539.19

2619. NUCLEAR QUADRUPOLE COUPLING IN THE ALKALI CHLOROIODIDES. I. CHLORINE RESONANCES.
C.D.Cornwell and R.S.Yamasaki.
J. chem. Phys., Vol. 27, No. 5, 1060-7 (Nov., 1957).

Chlorine resonance frequencies are reported for the following at 298°, 194°, and 77°K: $CsICl_2$, $KICl_2$, $KICl_2 \cdot H_2O$, $CsICl_4$, $RbICl_4$, $KICl_4$, $KICl_4 \cdot H_2O$, $NaICl_4 \cdot 2H_2O$. Variations due to crystal effects in these substances amount in most cases to less than a megacycle. The average frequencies at room temperature, 19.2 and 22.3 Mc/s, are taken as representative of ICl_2^- and ICl_4^- ions, respectively, in a crystalline environment. These values are in the neighbourhood of half those found for ICl, and suggest a bonding scheme in which the electron distribution is shifted outward toward the chlorine atoms to such an extent that the electron population of iodine orbitals is not so large as to require the use of d orbitals. The conclusion is that d orbitals are rather less important to bonding in the polyhalides than has generally been supposed. The problem of arriving at a practical and meaningful separation of crystal and chemical effects is considered qualitatively, and marked crystal effects evident in the spectra of $KICl_4 \cdot H_2O$ and $NaICl_4 \cdot 2H_2O$ are briefly discussed. A.

539.19

2620. PROTON MAGNETIC RESONANCE CHEMICAL SHIFT OF FREE (GASEOUS) AND ASSOCIATED (LIQUID) HYDRIDE MOLECULES. W.G.Schneider, H.J.Bernstein and J.A.Pople.
J. chem. Phys., Vol. 28, No. 4, 601-7 (April, 1958).

In order to study the factors giving rise to proton resonance chemical shifts of free molecules, as well as the association shifts due to hydrogen bonding, proton resonance measurements were carried out for a variety of simple hydride molecules in both the liquid and gaseous states. It is found that the proton shifts in the gaseous state can be interpreted in terms of the combined effect of the electronegativity and magnetic anisotropy of the atom to which the proton is bonded. The proton signals measured in the liquid state near the melting point, which correspond to maximum association, show large shifts to lower magnetic field relative to the corresponding gas signals. It is suggested that the association, or hydrogen bond shifts, in a system Y–H–X can be interpreted largely in terms of the reduction of the diamagnetic circulation in the H–X bond by the electrostatic field of the Y donor. Further possible contributions in certain anomalous cases are also considered. A.

539.19

2621. APPLICATION OF THE METHOD OF DEFORMED ATOMS IN MOLECULES TO THE Li_2 MOLECULE. T.Arai and M.Sakamoto.
J. chem. Phys., Vol. 28, No. 1, 32-48 (Jan., 1958).

The method of deformed atoms in molecules, proposed previously to remedy deficiencies in the method of Moffitt, is employed to calculate energies of the ground state $^1\Sigma_g^+$ and the lower excited states $^3\Sigma_u^+$, $^1\Sigma_u^+$, and $^1\Pi_u$ of the Li_2 molecule. As basis for the molecular calculation, modified atomic functions are introduced to take deformation of atoms in molecules into account. The modified functions are constructed from atomic eigenfunctions in a manner which fully preserves correlation between electrons. Exact atomic energies are used to calculate the atomic energy parts of the matrix elements of the molecular calculation, while the energy defects due to deformation of atoms are determined by using approximate functions. The modified atomic functions are made up so that their charge distributions are well described by the use of Slater orbitals with equal orbital exponents for all atomic states. Interatomic interaction operators, overlap integrals and energy defects due to deformation of atoms are calculated using Slater orbitals. For the $1s)^2 2s) 2p)^3P$ and ^1P states of the Li^-ion, the exchange correction due to binding a free electron into the 2p orbital is considered. The energy defects of Slater orbitals from Hartree–Fock orbitals are found to have small effect on the dissociation energy of the ground state. The calculations are performed for three sets of values for the orbital exponents. The dissociation energy obtained for one set of values if 0.96 eV, in good agreement with the observed value of 10.5 eV. The excitation

energies obtained of 1.63 eV for $^3\Sigma_u^+ - {}^1\Sigma_g^+$, 2.05 eV for $^1\Sigma_u^+ - {}^1\Sigma_g^+$ and 2.59 eV for $^1\Pi_u - {}^1\Sigma_g^+$ also agree reasonably well with the corresponding observed values of (1.35 eV), 1.76 eV and 2.54 eV. The calculation is discussed and compared with the orbital approach and Moffitt's method. Conclusions are stated regarding the nature of bonds and orbital exponents in Li_2. A.

539.19

2622. CHEMICAL BOND. II. A ONE-DIMENSIONAL APPROACH TO THE ENERGETICS AND IONIC CHARACTER. G.M.Barrow.
J. chem. Phys., Vol. 28, No. 3, 485-92 (March, 1958).

For previous part see Abstr. 4843 (1957). One-dimensional counterparts of atomic bonding orbitals are given which allow, in the LCAO method, calculation of binding energies and electronic distributions for single bonds between atoms of various electronegativities. The bond energies and ionic characters so calculated are shown to be in satisfactory agreement with the values observed for a number of bonds. Predictions are then made of the ionic character of a bond as a function of electronegativity difference and bond length. The potential usefulness of the approach is stressed in terms of the simplicity of the model and of the calculations and the essential correctness of the theoretical results. A.

539.19

2623. QUANTUM MECHANICS OF THE H_3 COMPLEX.
G.E.Kimball and J.G.Trulio.
J. chem. Phys., Vol. 28, No. 3, 493-7 (March, 1958).

A minimum energy and the associated nuclear configuration are given for linear symmetric H_3 in the ground ($^2\Sigma_u^+$) state. An LCAO MO wave-function with complete configuration interaction, is constructed from a set of five 1S hydrogen-like orbitals with centres equally spaced on the line of nuclei. Apart from symmetry, nuclear positions and orbital centres are unrelated but the screening constant is the same for each orbital. The nonlinear parameters which were varied are the screening constant, internuclear distance, and the distance between adjacent orbital centres. An energy of -72.4 ± 0.5 kcal/mole (relative to three separated H-atoms) is obtained; the experimental value is ~ -103 kcal/mole. Many difficult 3- and 4-centre repulsion integrals were evaluated numerically, using the C.P.C. at Watson Scientific Computing Laboratory. The chief advantage of this model is that all the difficult integrals belong to one family characterized by essentially three parameters. Thus, all of them were computed from a single numerical programme. A.

539.19

2624. ELECTRONIC STRUCTURES OF THE METHYL RADICAL: EFFECT OF 3s ATOMIC ORBITAL OF CARBON. J.Higuchi.
J. chem. Phys., Vol. 28, No. 4, 527-31 (April, 1958).

By taking the 3s orbital of carbon into account, the self-consistent-field (SCF) LCAO-MO method is applied to the ground state of the methyl radical. The 3s AO used is determined for the valence state $V_4(1s^22s2p\pi + 2p\pi - 3s)$ by a variational procedure, so that the orbital exponent of the 3s simple Slater AO obtained is 0.6374 instead of Slater's value 0.4833. For the other states with 3s AO, it is similarly concluded that good approximate 3s orbitals cannot be obtained by using Slater's rule, and more satisfactory shielding constants for the extra-valence-shell electron are given. Interactions between all electrons are taken into consideration but the orthogonality relationship between 1s orbitals of carbon and hydrogen is assumed. For the MOs occupied in the ground state, the forms are hardly changed by the inclusion of the 3s AO, and the contribution of the 3s AO is very small. For the lowest vacant orbital, however, this contribution is exceedingly great and qualitatively the conventional approximation by the 3s AO is rather more satisfactory than the use of the anitbonding LCAO-MO constructed by the valence-shell orbitals. In the lower electronic states calculated, such properties are prominent and the agreements with the observations are relatively good, especially by the inclusion of the 3s AO. The influence of the other extra-valence-shell orbitals is discussed. A.

539.19

2625. ROLE OF ATOMIC VALENCE STATES IN MOLECULAR ENERGY CALCULATIONS. A.C.Hurley.
J. chem. Phys., Vol. 28, No. 4, 532-42 (April, 1958).

Ab initio calculations of molecular binding energies are examined critically in a basis of antisymmetrized products of approximate atomic state functions (the approximate composite functions of Moffitt). It is shown that much more accurate results may be expected if the binding energy is calculated relative to a suitably defined generalized valence state V of the dissociation products. The energy of this state V relative to the ground state of the dissociation products is estimated from atomic spectral data. This procedure leads directly to the intra-atomic correlation correction previously proposed by the author as a necessary modification of Moffitt's method of atoms in molecules. Detailed calculations are carried out for the ground states of the molecules LiH and BH, and for the ground and excited states of the benzene molecule (in the usual π-electron approximation). In each case the intra-atomic correlation correction leads to a substantial improvement in the accuracy of the results. A.

539.19

2626. NONSTOICHIOMETRY AND LATTICE DEFECTS IN URANIUM HYDRIDE. G.G.Libowitz.
J. chem. Phys., Vol. 27, No. 2, 514-18 (Aug., 1957).

Expressions are derived for the hydrogen pressure over nonstoichiometric metallic hydrides from statistical mechanical considerations. Two separate relations are obtained depending on whether lattice vacancies or interstitial atoms are taken to be the cause of hydrogen deficiency in hydrides. For the case of one-to-one binary hydrides, the two equations become identical. By comparing the pressure—temperature—composition data for uranium hydride with the derived equations, it is established that the nonstoichiometry of this compound is due to hydrogen vacancies in the lattice rather than interstitial uranium atoms. The energy necessary to form a hydrogen vacancy in uranium hydride is found to be 68.2 kcal/mole, while a value of 6.5 kcal/mole is determined for the interaction energy between vacancies. A.

539.19

2627. ISOTOPE EFFECT AND STRUCTURE OF THE B_2O_3 AND B_4O_6 MOLECULES. W.J.Taylor.
J. chem. Phys., Vol. 28, No. 4, 625-9 (April, 1958).

A systematic application of the Teller—Redlich product rule to the isotope effect is carried out for several of the most likely structures of the B_2O_3 molecule, and tetrahedral B_4O_6. It is pointed out than an isotope effect of the magnitude reported by Dows and Porter in the infrared emission (2013 and 2114 cm^{-1} for $B_2{}^{11}O_3$ and $B_2{}^{10}O_3$, respectively) is incompatible with the bipyramidal (D_{3h}) model they consider, as well as with the linear ($D_{\infty h}$) structure. Less symmetrical structures of B_2O_3 (C_2, C_{2V}, and C_{3V} symmetries) are not excluded; neither is the tetrahedral B_4O_6 structure. These conclusions are reached by using in conjunction with the product rule the theorem that the frequency of each and every vibrational mode of a molecule is a monotonic function of each atomic mass. This makes it possible to set bounds on the isotope effect of individual modes of each symmetry type, and this procedure should be generally useful. A proof of the theorem stated is given in an appendix. A.

539.19

2628. DIPOLE MOMENT OF PERCHLORYL FLUORIDE.
A.A.Maryott and S.J.Kryder.
J. chem. Phys., Vol. 27, No. 5, 1221-2 (Nov., 1957).

Measurements of the non-resonant dielectric loss for frequencies of 2300 Mc/s and 9065 Mc/s give a value of $\mu = 0.023$ D for ClO_3F. G.I.W.Llewelyn

539.19 : 541.24

2629. NEW ABSOLUTE MOLECULAR WEIGHT METHOD (LINEAR HIGH POLYMERS). F.Bueche and S.W.Harding.
J. chem. Phys., Vol. 27, No. 5, 1210 (Nov., 1957).

The shear-rate dependence of the viscosity of polystyrene and of polymethylmethacrylate in a variety of solvents was measured using a cone viscometer and the molecular weights of the polymeric molecules computed. These compare favourably with the molecular weights as obtained from dilute solution viscosity indicating that the shear-rate molecular-weight method has great promise. W.Good

539.19

2630. SHOCK TUBE STUDY OF DISSOCIATION RELAXATION IN OXYGEN. H.S.Glick and W.H.Wurster.
J. chem. Phys., Vol. 27, No. 5, 1224-6 (Nov., 1957).

Schlieren studies of density distribution behind the shock front give vibrational relaxation times in agreement with those found by Blackman between 1600° and 3000°K. Above 3000°, the zone broadens, due to the longer dissociation relaxation. Values for this were determined between 3000° and 3800°K; they agree with theoretical estimates by Evans and by Logan, but are three orders less than predicted by Bethe and Teller. A.G.Gaydon

SOLID-STATE PHYSICS

539.19

2631. DRUDE-MODEL CALCULATION OF DISPERSION FORCES. I. GENERAL THEORY. W.L.Bade.
J. chem. Phys., Vol. 27, No. 6, 1280-4 (Dec., 1957).

The dipole–dipole part of the London–van der Waals interaction energy of a system of N molecules is calculated in the general order of perturbation, using a model which represents each molecule as an isotropic harmonic dipole-oscillator. The calculation assumes that the characteristic dispersion frequencies of the molecules are all equal. The advantage and limitations of the oscillator model are discussed. A.

539.19

2632. DRUDE-MODEL CALCULATION OF DISPERSION FORCES. II. THE LINEAR LATTICE. W.L.Bade and J.G.Kirkwood.
J. chem. Phys., Vol. 27, No. 6, 1284-8 (Dec., 1957).

The London-van der Waals cohesive energy of a linear lattice is calculated in the dipole–dipole approximation, including all orders of perturbation. This result is obtained by applying the Born–von Kármán method to the electronic motions, using a model which represents each molecule as an isotropic harmonic dipole-oscillator. The dispersion interaction energy of the lattice is expanded in powers of the parameter α/a^3 (where α is the molecular polarizability and a the nearest neighbour distance), and is computed up to the eighth order. For values α/a^3 appropriate to actual molecular crystals, the main contribution to the energy comes from the second order. Among the higher-order terms, the third order is always important, but for $\alpha/a^3 \geq 0.06$, contributes less than one-half of the total correction to the second-order energy. A.

539.19

2633. DRUDE-MODEL CALCULATION OF DISPERSION FORCES. III. THE FOURTH-ORDER CONTRIBUTION. W.L.Bade.
J. chem. Phys., Vol. 28, No. 2, 282-4 (Feb., 1958).

The results of Pt I are applied in calculating the fourth-order dipole–dipole contribution to the dispersion interaction energy of a system containing N identical spherical molecules. This contribution to the energy consists of pair terms proportional to R_{ij}^{-12}, triplet terms proportional to $(R_{ij}R_{jk})^{-6}$, and quadruplet terms proportional to $(R_{ij}R_{jk}R_{kl}R_{li})^{-3}$, where R_{ij} is the separation of the ith and jth molecules. The expression for the fourth-order energy is summed approximately over the face-centred-cubic lattice. The result is $E^{(4)} \simeq -100N\ V\ (\alpha/R_0^3)^4$, where α is the polarizability and V the characteristic dispersion energy of the molecules, R_0 is the nearest-neighbour distance in the lattice, and N is the number of molecules in the crystal. The triplet terms are responsible for the main contribution to this sum. The fourth-order dipole–dipole dispersion energy of the lattice is negative and comparable in magnitude with the positive triple-dipole energy computed by Axilrod and others, in cases where the latter contribution is substantial. A.

539.19

2634. DELTA-FUNCTION MODEL FOR SHORT-RANGE INTERMOLECULAR FORCES. I. RARE GASES.
E.A.Mason and J.T.Vanderslice.
J. chem. Phys., Vol. 28, No. 3, 432-8 (March, 1958).

A delta-function model is proposed for the calculation of short-range intermolecular forces. The features which must be incorporated into such a model to make it yield quantitative results for repulsion energies are investigated by considering first the repulsion interaction of two hydrogen atoms with parallel electron spins. Extension to the rare gas atom interactions is then made by replacing their many electrons by an effective charge distribution. This procedure permits the simple treatment developed for hydrogen atoms to be taken over formally for rare gas atoms. Interactions between unlike atoms are also considered. As finally formulated, there are no disposable parameters and the interaction energy is directly related to known properties of the isolated atoms. The properties needed are the atomic number, the first ionization potential, and the average radius of the largest electronic orbit. Agreement with experiment is good in all cases, and is almost always superior to that achieved by conventional valence bond or molecular orbital methods. A.

539.19 : 536.7

2635. THERMODYNAMIC FUNCTION OF CARBONYL CHLORIDE. J.S.Gordon and D.Goland.
J. chem. Phys., Vol. 27, No. 5, 1223-4 (Nov., 1957).

Data have been extended to 4000°K, using harmonic oscillator functions and neglecting rotational stretching and rotation–vibration interactions and anharmonicity. Values of the equilibrium constant for dissociation to CO + 2Cl, and other functions, are listed at 100 deg intervals. A.G.Gaydon

539.2

2636. CRYSTAL FIELD EFFECTS IN METALS. R.S.Leigh.
Proc. Phys. Soc., Vol. 71, Pt 1, 33-7 (Jan., 1958).

Considers the errors made in band structure calculations by using a potential which is spherically symmetric inside the inscribed spheres of the atomic polyhedra and constant between the spheres. Numerical estimates are obtained for the conduction bands in Na, Fe, Al, Cu and the d-band in Fe. D.M.Edwards

539.2

2637. SOME ELECTRON DISTRIBUTION DETERMINATIONS BY X-RAY DIFFRACTION. W.Cochran.
Rev. mod. Phys., Vol. 30, No. 1, 47-50 (Jan., 1958).

Results of measurements on NH_4HF_2 and LiH are given, and there is a discussion on electron density distribution in bonded hydrogen. A.R.Stokes

539.2

2638. ELECTRON DISTRIBUTIONS IN NaCl, LiF, CaF_2, AND Al. H.Witte and E.Wölfel.
Rev. mod.Phys., Vol. 30, No. 1, 51-5 (Jan., 1958).

Electron density maps are given for these structures. The method of eliminating effects of extinction is described. A.R.Stokes

539.2

2639. INFLUENCE OF MASS FLUCTUATIONS IN A CRYSTAL ON THE PHONON MEAN FREE PATH. J.Tavernier.
C.R. Acad. Sci. (Paris), Vol. 245, No. 20, 1705-8 (Nov. 13, 1957).
In French.

539.2 : 539.12

2640. MEAN FREE PATH OF PHONONS IN A LEAD CRYSTAL. G.J.McCallum and P.A.Egelstaff.
Nature (London), Vol. 181, 643-4 (March 1, 1958).

The spectrum of "cold" neutrons scattered from a Pb crystal was measured with the crystal at temperatures of 80° and 300°K respectively and compared with that predicted on the assumption of a "one-phonon" process, the cold neutrons being obtained using the liquid-hydrogen source in BEPO. The phonon mean free path at 80°K was found to be greater than 180 A, at 300°K the mean free path was 110 A. At 300°K the increase in the number of neutrons losing energy was only one third of that expected, a discrepancy which is not so far explained. The results give a value of 0.05 ± 0.03 barns for the incoherent elastic scattering cross-section of lead, which is better than previous measurements. J.Thewlis

539.2

2641. DETECTION OF OPTICAL LATTICE VIBRATIONS IN Ge AND ZrH BY SCATTERING OF COLD NEUTRONS.
I.Pelah, C.M.Eisenhauer, D.J.Hughes and H.Palevsky.
Phys. Rev., Vol. 108, No. 4, 1091-2 (Nov. 15, 1957).

"Cold" neutron beams, produced by filtering thermal neutrons in Be, were scattered by the specimen under investigation, and the spectrum of scattered neutrons analysed by the slow-chopper, time-of-flight method. An improved chopper was used, with a resolution of 3 μsec/m. Sharp peaks were observed in the energy of the scattered neutrons, resulting from a gain of energy by the neutrons from the optical vibrations of the specimens. A single crystal of Be was investigated and the ZrH specimen was polycrystalline. J.Thewlis

539.2

2642. NEUTRON INVESTIGATION OF OPTICAL VIBRATION LEVELS IN ZIRCONIUM HYDRIDE. A.Andresen, A.W.McReynolds, M.Nelkin, M.Rosenbluth and W.Whittemore.
Phys. Rev., Vol. 108, No. 4, 1092-3 (Nov. 15, 1957).

Reports in greater detail the work on ZrH referred to in the preceding abstract. The peak arising from optical vibrations was studied and the energy of the optical level found to be 0.130 ± ± 0.005 eV. The cross-section for energy gain from the optical level is calculated for a one-phonon process to be about 0.9 barn at 24°C for neutrons of incident energy 0.004 eV. The total inelastic scattering cross-section is found to be about 2 barns, and since between 35% and 50% is due to the optical level the "optical" cross-section is between 0.7 and 1.0 barn, in good agreement with the above figure of 0.9. J.Thewlis

539.2

2643. PHONON–POLARON PROBLEM. F.R.Halpern.
Phys. Rev., Vol. 109, No. 5, 1836-41 (March 1, 1958).

The method of moments is employed to determine the ground state of the phonon–polaron system. The trial function employed in this calculation is a bare-electron wave-function. It appears that the method is convergent for this problem. Although the energy is in general a complicated function of the parameter and must be determined numerically, it is possible to formally construct a power series expansion for the energy about the unperturbed energy in powers of the coupling constant. The first term in this series has been determined and agrees with the result of conventional perturbation theory. The second term has not yet been evaluated to all orders but it appears that it will have the opposite sign from the corresponding term in perturbation theory. The second and higher terms in some orders of approximation are singular for small values of the cutoff. A.

539.2

2644. CELLULAR METHOD FOR WAVE FUNCTIONS IN IMPERFECT METAL LATTICES. W.A.Harrison.
Phys. Rev., Vol. 110, No. 1, 14-25 (April 1, 1958).

A general method is proposed for constructing conduction-band wave-functions in nonperiodic monovalent metals and alloys. The method is a cellular approximation in which it is assumed that the lattice potential can be considered to be spherically symmetric within ellipsoidal cells centred on the individual ions. It is shown that the resulting wave-functions are correct, within this approximation, to first order in a parameter which corresponds to the wave-number in a perfect crystal. In the case of a strained metal in which the strains vary slowly in space the method takes a form analogous to the deformation-potential formalism, but contains a term which is first-order in the derivatives of the strain. The individual ionic potentials enter the procedure through parameters which are evaluated and tabulated for all of the alkali and noble metals. These parameters correspond to deformation-potential constants when that approximation is valid. The general procedure is written in a form which is convenient for treating electron scattering, and the case of point defects is discussed. In particular, the influence of the lattice distortion on the scattering is considered in some detail. The scattering of electrons by stacking faults is discussed, and some of the features of scattering by lattice vibrations in solid and liquid metals are considered. A.

539.2

2645. BAND STRUCTURE AND COHESIVE ENERGY OF POTASSIUM CHLORIDE. L.P.Howland.
Phys. Rev., Vol. 109, No. 6, 1927-43 (March 15, 1958).

The band structure of crystalline KCl has been calculated in an L.C.A.O. (linear combination of atomic orbitals) approximation. Interactions between free-ion Hartree–Fock functions are calculated directly from molecular-type integrals without reducing exchange interactions to an exchange potential. The structure of the filled bands of KCl is obtained by solving secular equations on a cubic mesh of points in k-space. The valence band is found to be quite narrow, about 1.5 eV wide, but the band-structure results do not explain the observed X-ray emission data for KCl. The band structure is recalculated in less detail as a function of interionic distance. Numerical quantities for the band-structure calculation are used also to calculate the cohesive energy of KCl at its normal interionic distance by Löwdin's method. Inclusion of the second-neighbour interactions here is found to raise Löwdin's equivalent of the repulsive energy from 18.9 kilocalories per mole to 26.2 kilocalories per mole and thus to raise the total cohesive energy above the experimentally-determined value, in line with expectation. A.

539.2

2646. PROPAGATION OF ELECTRONIC EXCITATION IN INSULATING CRYSTALS. R.E.Merrifield.
J. chem. Phys., Vol. 28, No. 4, 647-50 (April, 1958).

A general method for the description of nonstationary excited states of an insulating crystal is outlined. For the general case, the time-dependent wave-function is given implicitly by means of a simple generating function. In the nearest-neighbour approximation, the solution can be given explicitly in terms of Bessel functions. The effect of an idealized crystal surface on exciton propagation is examined. The exciton behaves as though repelled by the surface. A.

539.2

2647. SELECTION RULES FOR THE ABSORPTION OF POLARIZED ELECTROMAGNETIC RADIATION BY MOBILE ELECTRONS IN CRYSTALS. M.Sachs.
Phys. Rev., Vol. 107, No. 2, 437-45 (July 15, 1957).

Group-theoretical methods are employed to obtain the selection rules for the absorption of polarized E1, M1, and E2 electromagnetic radiation by mobile electrons which are near energy-band extrema. both the single-valued and double-valued groups appropriate to several symmetry points in the reduced zones of simple-cubic, face-centred-cubic, body-centred-cubic, and hexagonal-close-packed lattice symmetries are considered. The symmetry properties at various points in the reduced zone are also used to derive expressions for the electron energy as a function of the wave vector k in the neighbourhood of nondegenerate extremum states. The results obtained are applied to a consideration of the change in optical selection rules when single crystals of indium antimonide are subjected to a shearing stress. A.

539.2

2648. ELECTRONIC ENERGY BANDS IN LITHIUM.
M.L.Glasser and J.Callaway.
Phys. Rev., Vol. 109, No. 5, 1541-3 (March 1, 1958).

The orthogonalized plane wave method is applied to a calculation of energy bands in metallic lithium. An empirical potential, constructed by Seitz, is used. Energies are obtained for states belonging to twenty-four symmetry types at four points of the Brillouin zone. The energy of the lowest state of a valence electron determined in this work is in good agreement with a previous cellular method calculation. The states which bound the lowest band are found to be of predominatly P type. A.

539.2

2649. VISCOSITY OF THE ELECTRON GAS IN METALS.
M.S.Steinberg.
Phys. Rev., Vol. 109, No. 5, 1486-92 (March 1, 1958).

With a view toward explaining measurements of ultrasonic attenuation in metals, the coefficient of shear viscosity of a free electron gas interacting with thermal phonons and local crystal in inhomogeneities is computed. The methods employed are essentially those developed for the problem of electrical conductivity. By means of a variational principle, a general formal solution is obtained. The effective mean free path is found to be somewhat smaller and of a somewhat more complicated (though not qualitatively different) temperature dependence than that associated with electrical conduction. The effect of a transverse magnetic field is determined for the case when a time of relaxation exists. A.

539.2

2650. GENERALIZED MOBILITY THEORY. M.Lax.
Phys. Rev., Vol. 109, No. 6, 1921-6 (March 15, 1958).

A formal theory of mobility is presented that does not depend on the existence of a transport equation. In particular the Hamiltonian describing the electron plus scattering system is not decomposed into an unperturbed part plus a perturbation. Only the applied field is treated as small. The result obtained is shown to reduce to the usual transport result when the scattering perturbation is weak, without the existence of a relaxation time. Further verification of the validity of this result is obtained by using it to demonstrate a complex Nyquist theorem. Mathematical convergence factors introduced in previous theories are shown to arise naturally here by allowing a weak interaction between the electron plus scattering systems and the universe. The relation between a many-electron treatment and the one-electron treatment is demonstrated for the case of Fermi as well as Boltzmann statistics. A.

539.2 : 537.311.33

EXCITON MECHANISM OF CAPTURE OF CURRENT CARRIERS IN SEMICONDUCTORS. See Abstr. 2309

539.2

2651. AN EXPERIMENTAL DETERMINATION OF THE FERMI SURFACE IN COPPER. A.B.Pippard.
Phil. Trans A, Vol. 250, 325-57 (Dec. 12, 1957).

Measurements were made of the variation with crystal orientation of the anomalous skin resistance of plane surfaces of pure copper at low temperatures and at a frequency of 22700 Mc/s. The resistance is related to the geometrical form of the Fermi surface, and a surface is determined which has the correct shape to account for the experimental results. It is believed that there is no other solution which would give equally good agreement. As determined,

the surface, which holds one electron per atom, will not quite fit into the Brillouin zone, overlapping in the (111) directions where the zone boundary is closest to the origin. From an examination of simple models it is concluded that probably there is contact with the zone boundary over small areas around these points, and the energy gap across these boundaries is estimated to be about 7½ eV. Apart from extension to the boundaries in the (111) directions the Fermi surface is more or less spherical. An estimate is made of the Fermi velocity and its variations over the surface, from which it is concluded that the electronic specific heat should lie between 1.7 and 1.9 times that of a free-electron model of copper. The experimental value is 1.38, and it is tentatively suggested that the discrepancy may find an explanation in the theory of Bohm and Pines. Various transport phenomena are briefly discussed, but no reliable evidence is discovered bearing directly on the shape of the Fermi surface. It is concluded that the method, though laborious in interpretation, may be applied with advantage to other simple metals such as silver and gold. A.

539.2

2652. ON THE FERMI SURFACE OF COPPER. F.G.Mollner.
Phil. Mag. (Eighth Ser.), Vol. 3, 207 (Feb., 1958).

Pippard's results (preceding abstract) are fitted to 1% accuracy by an expression of the form resulting from a tight-binding model considering first and second nearest neighbours.

D.M.Edwards

539.2

2653. SPONTANEOUS EMISSION OF RADIATION FROM AN ELECTRON SPIN SYSTEM. G.Feher, J.P.Gordon, E.Beuhler, E.A.Gere and C.D.Thurmond.
Phys. Rev., Vol. 109, No. 1, 221-2 (Jan. 1, 1958).

A direct observation is described of the spontaneous and coherent emission into a cavity, resonant at the Larmor precession frequency, of energy which has been stored in an electron spin system. The specimen used was a single crystal of isotopically purified Si^{28} (99.88 ± 0.08%) containing 4×10^{16} phosphorus donors per cm^3. The removal of most of the Si^{29} normally present was necessary to reduce the absorption line-width to a low enough value for the condition for spontaneous oscillation to be satisfied. J.M.Baker

539.2

2654. ELECTRON SPIN RESONANCE OF H CENTERS.
W.Känzig and T.O.Woodruff.
Phys. Rev., Vol. 109, No. 1, 220-1 (Jan. 1, 1958).

A paramagnetic resonance spectrum is observed in a KCl crystal, X-irradiated at 20°K, which is attributed to an electron whose wave-function is spread over four chlorine nuclei, in a line along the 110 direction in the crystal. A hyperfine structure is observed due to interaction of the electron with all four of these chlorine nuclei. The spectrum disappears on annealing between 42°K and 60°K. As this is the temperature range where the optical H band is bleached it is suggested that the centres are H centres.

J.M.Baker

539.2

2655. CYCLOTRON RESONANCE IN GRAPHITE. P.Nozières.
Phys. Rev., Vol. 109, No. 5, 1510-21 (March 1, 1958).

The model of the bands proposed by Slonczewski and Weiss for graphite single crystals is described in some detail. It is then applied to a study of the cyclotron resonance absorption in graphite, taking into account plasma effects. This theory is then compared to the experimental data of Galt et al. The comparison leads to the conclusion that the charge carriers consist of holes with effective masses ranging from 0.066 m to 0.054 m, and electrons with effective masses from 0.054 m to 0. The present information on the band structure of graphite is gathered in the conclusion. A.

539.2

2656. PARAMAGNETIC RESONANCE [OF ELECTRONS] AND POLARIZATION OF NUCLEI IN METALS.
M.Ya.Azbel', V.I.Gerasimenko and I.M.Lifshits.
Zh. éksper. teor. Fiz., Vol. 32, No. 5, 1212-25 (1957). In Russian.

A theory of paramagnetic resonance of electrons in metals is proposed which is based on the simultaneous solution of Maxwell's equations and the kinetic equation for the density operator. The nuclear polarization which appears in this case is determined. It is shown that this polarization varies very slowly with the depth, decreasing exponentially at a depth of 10^{-3} — 1 cm which is the mean path traversed by an electron between collisions involving spin reversal. It is found that paramagnetic resonance entails selective transparency of metallic films. A.

539.2 : 537.312.62

2657. THEORY OF ELECTRON PARAMAGNETIC RESONANCE IN SUPERCONDUCTORS. M.Ya.Azbel' and I.M.Lifshits.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 792-4 (1957). In Russian.

No resonance is to be expected in bulk superconductors, because the time spent by an electron in the penetration depth is much too small. Application of formulae of Azbel', Gerasimenko and Lifshits (see preceding abstract) shows that a steady magnetic field decays more gradually into the depth of a superconductor if an r.f. field is also present. D.Shoenberg

539.2

2658. FINE STRUCTURE OF THE ELECTRON PARAMAGNETIC RESONANCE SPECTRUM OF Fe^{3+} IONS IN AN Al_2O_3 LATTICE.
L.S.Kornienko and A.M.Prokhorov.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 805-7 (1957). In Russian.

From the fine-structure experiments, the parameters of the phenomenological Hamiltonian are found. Results relating to the isotope Fe^{57} confirm the smallness of its nuclear magnetic moment.

S.F.Edwards

539.2

2659. PARAMAGNETIC IMPURITIES IN NaF.
W.Hayes and D.A.Jones.
Proc. Phys. Soc., Vol. 71, Pt 3, 503-5 (March, 1958).

Single crystals of NaF were grown from melts containing 0.01% molar concentration of Mn^{++}, Cr^{+++}, Co^{++} and Ni^{++} ions. Paramagnetic resonance was observed due to Mn^{++} and Co^{++} ions. After irradiation with X-rays, γ-rays or electrons, resonance was observed due to Co^{+}, Ni^{+} and Cr^{+} ions. The latter resonances are destroyed by annealing. J.M.Baker

539.2

2660. OBSERVATION OF NUCLEAR RESONANCE ACOUSTIC ABSORPTION OF In^{115} IN InSb. M.Menes and D.I.Bolef.
Phys. Rev., Vol. 109, No. 1, 218-19 (Jan. 1, 1958).

The absorption of acoustic energy (arising from spin—lattice coupling) was observed at the normal resonance frequency ($\Delta m = \pm 1$) and at the double frequency ($\Delta m = \pm 2$). The sample was a cylinder of p-type InSb with faces normal to [321], and the absorption was determined from the change in electrical impedance of a quartz transducer glued to these faces. The absorption at both frequencies varied strongly with the angle between the magnetic field and the [321] axis. B.T.M.Willis

539.2

2661. INTERACTION BETWEEN CURRENT CARRIERS AND F-CENTRES WITH ACOUSTICAL VIBRATIONS OF IONIC CRYSTAL LATTICES. M.F.Deigen and V.L.Vinetskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1382-92 (1957). In Russian.

Interactions between a "surplus" electron in an ionic crystal with the optical and acoustical vibrations of the lattice is considered. Inclusion of interaction with acoustical vibrations leads to a reduction of the energy of the system and to a change in the effective mass of the current carrier as compared with the polaron. The wave-functions, energies of the ground and excited states of the F-centers and the parameters of the F-absorption band are computed taking into account "condenson" interaction. A comparison of polaron and condenson effects in ionic crystals is carried out. A.

539.2

2662. DETERMINATION OF THE ACTIVATION ENERGY OF VACANCY MIGRATION IN COPPER BY ULTRASONIC METHODS.
A.Granato, A.Hikata and K.Lücke.
Phys. Rev., Vol. 108, No. 5, 1344-5 (Dec. 1, 1957).

The recovery of the measured elastic modulus from its reduced value in slightly deformed specimens is attributed to the pinning of dislocations by vacancies. A relation is given between the reduction in modulus and the recovery time. The temperature dependence of a parameter which appears is related to U_M, the activation energy of vacancy migration. An analysis of Smith's results (Abstr. 7987/1953) on this basis leads to a value of 1.0 eV for U_M in copper. D.M.Edwards

539.2

2663. PROPAGATION OF DISLOCATIONS IN ELECTRON IRRADIATED LITHIUM FLUORIDE. A.D.Whapham.
Phil. Mag. (Eighth Ser.), Vol. 3, 103-4 (Jan., 1958).

Dislocations were produced in LiF by making small indentations in a (100) cleavage face and then revealed by etching. In unirradiated LiF the dislocation etch pits make a star pattern extending out for several diameters of the indentation hole. The patterns around

indentations made after irradiation (1 MeV electrons) are much smaller and extend for only about one diameter, showing that irradiation hinders the glide of dislocations. A.B.Lidiard

539.2

2664. DISLOCATIONS IN CAESIUM BROMIDE. S.Amelinckx.
Phil. Mag. (Eighth Ser.), Vol. 3, 307-9 (March, 1958).

Colloidal Au can be dispersed in a CsBr crystal, preferentially along dislocations, by a procedure involving heat treatment with $HAuBr_4$, quenching, and two anneals, so that the crystal is suitably decorated for ultramicroscopic illumination. Alternative techniques begin with the evaporation of Au or Ag on to the crystal in vacuo. The emergence points of individual dislocations have been observed. J.G.Oldroyd

539.2

2665. ELECTRICAL METHODS FOR DETERMINING THE POSITIONS OF DISLOCATION REGIONS IN GERMANIUM. C.A.Hogarth and A.C.Baynham.
Proc. Phys. Soc., Vol. 71, Pt 4, 647-53 (April, 1958).

It is shown that the walls of edge dislocations which exist in germanium crystals grown on a deformed seed are regions of high electrical conductivity in both n- and p-type samples. By means of simple plotting of potential against distance at constant current or from point-contact rectification measurements the positions of such dislocation walls may be located, the results agreeing with the positions determined by etch-pit examination of the surfaces at which dislocations emerge. Evidence of the p-type character of dislocations in n-type germanium is presented. A.

539.2 : 537.311.31

2666. INTERPRETATION OF THE QUENCHING EXPERIMENTS ON GOLD. J.S.Koehler, F.Seitz and J.E.Bauerle.
Phys. Rev., Vol. 107, No. 6, 1499-505 (Sept. 15, 1957).

The behaviour of vacancies in Au during quenching is treated theoretically under the assumption that the total number is conserved, although they may aggregate into pairs and triplets. Approximate solutions of the equations governing the abundance of isolated vacancies is obtained in the case in which only a small fraction aggregate, i.e. in the limit in which the quench is very rapid. This situation appears to correspond to that observed in Au when the rate of quench is near 3×10^4 deg/sec. It is concluded that the binding energy of a pair of vacancies is between 0.1 and 0.2 eV and that the activation energy for migration of a pair is lower than that of a single vacancy by no more than 0.2 eV. A.

539.2

2667. STRUCTURE OF THE DISORDERED PHASE OF HCl. G.L.Hiebert and D.F.Hornig.
J. chem. Phys., Vol. 27, No. 5, 1216-17 (Nov., 1957).

Measurement of the infrared absorption spectrum of 3% of DCl in HCl shows that the DCl vibration shifts from 1983 to 2008 cm^{-1} and broadens on passing up through the ordered–disordered transition at 98.8°K. The shift can be ascribed to the general lattice expansion, and the broadening to a randomness of about 0.04 A in the Cl–H .. Cl distance. The narrow bands show that there is no rotation in either phase. G.F.Lothian

539.2

2668. ENTROPY OF HAUSMANNITE TO SPINEL TRANSFORMATION. K.S.Irani, A.P.B.Sinha and A.B.Biswas.
Proc. Phys. Soc., Vol. 71, Pt 2, 270-1 (Feb., 1958).

The entropy of randomization of orientation of distorted octahedra is calculated, in accordance with the model proposed by Finch, Sinha and Sinha. A.R.Stokes

539.21 : 537.311.31

DENSITY CHANGES IN Au–Cd UPON QUENCHING. See Abstr. 2296

539.21

2669. EFFECT OF NEUTRON IRRADIATION ON METALS AND ALLOYS. A.H.Cottrell.
J. Brit. Nuclear Energy Conf., Vol. 3, No. 1, 50-67 (Jan., 1958).

A review article covering the process of damage due to collision and absorption of neutrons, behaviour of fast ions knocking a large number of atoms out of position, comparison of estimated and measured damage, annealing of radiation damage, atomic rearrangements in alloys, radiation growth in uranium, mechanical properties of irradiated metals and alloys, effects due to chemically new atoms produced by neutron capture or fission and corrosion effects. 95 references. J.Adam

539.21

2670. STRUCTURAL BEHAVIOUR OF NEUTRON IRRADIATED QUARTZ. M.C.Wittels.
Phil. Mag. (Eighth Ser.), Vol. 2, 1445-61 (Dec., 1957).

X-ray and density studies were made on quartz single crystals irradiated in a reactor at ~ 100°C to a dose of 1.2×10^{20} neutrons/cm^2. Up to a dose of 3×10^{19} neutrons/cm^2 the crystal expands in a manner similar to the thermal expansion of unirradiated material and the volume increase is the same as determined by X-ray and hydrostatic methods. At higher doses the volume changes indicated by X-ray measurements are greater than the changes determined hydrostatically. Skewing of the (22.0) reflection observed at doses in excess of 8×10^{19} neutrons/cm^2 is interpreted as being due to the crowding of oxygen ion interstitials into the open c-axis channels. Diffuse X-ray haloes were observed and associated with the amorphous material enmeshed in the lattice. A second kind of diffuse halo appears after high irradiation doses. This is probably related to inhomogeneous lattice strains. Coesite, a high-density crystalline silica remains stable under irradiation doses which completely disorder quartz. J.Adam

539.21

2671. DIFFUSION-LIMITED ANNEALING OF RADIATION DAMAGE IN GERMANIUM. T.R.Waite.
Phys. Rev., Vol. 107, No. 2, 471-8 (July 15, 1957).

The theory given in Abstr. 2048 (1958) is used to treat the annealing of radiation damage in n-type germanium as studied by Fletcher, Brown, and Wright, and by Augustyniak. The damage was produced by 3 MeV electrons to a density of 10^{15} defects per cm^3. The damage was assumed to have consisted of vacancy-interstitial pairs which annealed by the diffusion together of interstitials and vacancies. A reasonable fit of the data is obtained for the initial 50% of the annealing. The data of Augustyniak were fit for all stages of the annealing process. Choice of parameters to fit the data led to the following conclusions: (1) The sum of the diffusion coefficients of interstitials and vacancies is given by $10^{11} r_0^2 \exp(-31.6 \text{ kcal/RT})$, where r_0 is the capture radius; (2) the average separation of the interstitial and the vacancy of the pairs produced by 3 MeV electrons is approximately 1.5 r_0, and (3) the first 65% of the annealing occurs by the recombination of each interstitial with the vacancy from which it was originally dislodged. Fair agreement of the activation energy with the previously accepted activation energy for vacancy diffusion suggests vacancy-diffusion annealing. Absence of a more rapid interstitial diffusion indicates that the interstitial does not possess the contracted electron cloud of a positive ion. A.

539.21

2672. RADIATION-INDUCED EXPANSION OF SEMICONDUCTORS. D.Kleitman and H.J.Yearian.
Phys. Rev., Vol. 108, No. 3, 901 (Nov. 1, 1957).

Crystals of GaSb, InSb and Ge were bombarded with 9 MeV deuterons at temperatures below –130°C. Surface topography and lattice parameter changes were studied. J.Adam

539.21

2673. EXPANSION OF COPPER UPON LOW-TEMPERATURE DEUTERON IRRADIATION. R.Vook and C.Wert.
Phys. Rev., Vol. 109, No. 5, 1529-37 (March 1, 1958).

The increase in linear dimensions of a 99.999% copper foil upon deuteron irradiation was measured directly as a function on integrated flux. Two bombardments were made on the same specimen with integrated fluxes of 3.14×10^{16} d/cm^2 and 7.68×10^{16} d/cm^2, respectively. It was found in both runs that the specific change in length per incident deuteron per square centimetre was 3.8×10^{-21}. This value applies to an average deuteron energy of 8.5 MeV. Measurements of the thermal recovery of the irradiation-induced change in length were also made. If the stages of thermal recovery between the bombardment temperature and room temperature are designated as Stage I (70°K), Stage II (70-180°K), and Stage III (180-300°K), then the amount of recovery per stage is 64%, 6%, and 26%, respectively. The residual effect remaining at 300°K is 4% of the maximum effect. It is suggested that the defects introduced by the deuteron irradiation are Frenkel pairs and that thermal recovery proceeds by means of recombination of vacancies and interstitials between the bombardment temperature of 17° and 300°K. A.

STRUCTURE OF SOLIDS

539.217

2674. VACANCY DIFFUSION IN BINARY ORDERED ALLOYS. E.W.Elcock and C.W.McCombie.
Phys. Rev., Vol. 109, No. 2, 605-6 (Jan. 15, 1958).

A theoretical discussion of the low-temperature diffusion coefficients of the components of an AB alloy is given assuming a mechanism of vacancy jumps between neighbouring sites. It is pointed out that short cyclic paths of the vacancy lead to diffusion without causing any net departure from the ordered condition and are thus compatible with the requirement of thermodynamic equilibrium. The ratio of diffusion coefficients D_B/D_A is calculated for a NaCl type of lattice [not for the CsCl type as stated]. A.B.Lidiard

539.217

2675. SELF-DIFFUSION IN SELENIUM. B.I.Boltaks and B.T.Plachenov.
Zh. tekh. Fiz., Vol. 27, No. 10, 2229-31 (1957). In Russian.

The self-diffusion coefficients, D, were determined at several temperatures for amorphous Se (35-56°C) and crystalline Se (35-140°C) by the method of successive removal of thin layers, using radioactive Se^{75} as an indicator. The Se was of "rectifier purity", the electrical conductivities of the amorphous and crystalline specimens used were 2.7×10^{-11} and 1.77×10^{-6} mho/cm respectively. For amorphous Se $D = 6.3 \times 10^{25} \exp(-2.3/kT) cm^2/sec$; for crystalline Se $D = 7.6 \times 10^{-10} \exp(-0.14/kT) + 1.4 \times 10^{-4} \exp(-0.51/kT)$ cm^2/sec. The two terms in the expression for crystalline Se are attributed to grain boundary and bulk diffusion respectively. It is thought that in crystalline Se the vacancy method of diffusion is operative, but in amorphous Se atoms diffuse between the tangled chains. K.F.Hulme

539.219

2676. THE THERMODYNAMICS OF ALMOST COMPLETELY ORDERED SOLID SOLUTIONS. M.A.Krivoglaz.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 2, 213-16 (1957). In Russian.

Near the critical temperature of a second-order phase change in an alloy, it is known that thermodynamic arguments are more useful than any particular model of order–disorder. This note considers the thermodynamics of the low-temperature state of almost complete order from this point of view. S.F.Edwards

539.219

2677. PRECIPITATION OF NICKEL AND COPPER FROM SUPERSATURATED SOLUTIONS IN GERMANIUM. P.Penning.
Philips Res. Rep., Vol. 13, No. 1, 17-36 (Feb., 1958).

When Ge supersaturated with Cu or Ni was annealed, unidentified acceptors of low activation energy were observed, as well as the usual levels associated with the impurities. The effect of duration of annealing was investigated. The results are explained by assuming that the new acceptors are vacancies left behind in the lattice when a substitutional Cu or Ni atom migrates to an interstitial site, and then diffuses to precipitation nuclei. The ratio of the densities of the substitutional atoms to the vacancies reaches a constant value (greater for Cu) during the first period of anneal. The vacancy acceptor level is 0.02 eV from the valence band. The application of this theory to the results of previous workers is also discussed. C.A.Hogarth

539.219 : 548.736.4

2678. SOLID SOLUTIONS OF LEAD-SULPHIDE, -SELENIDE AND -TELLURIDE. S.Yamamoto.
Sci. Rep. Tôhoku Univ. First Ser., Vol. 40, No. 1, 11-16 (Aug., 1956).

Powder photographs showed that PbS/PbSe solutions are single-phase throughout and have NaCl structure; similarly for PbSe/PbTe solutions. PbS/PbTe forms two phases. A.R.Stokes

539.219

2679. THEORY OF DIFFUSE SCATTERING OF X-RAYS AND THERMAL NEUTRONS IN SOLID SOLUTIONS. II. MICROSCOPIC THEORY. M.A.Krivoglaz.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1368-81 (1957). In Russian.

For Pt I see Abstr. 2287 (1957). Diffuse scattering of X-rays and thermal neutrons on composition and order fluctuations in solid solutions is considered. For disordered and ordered solutions of AB steichiometric composition the calculations are carried out taking into account the interaction between atoms lying in coordination spheres separated by arbitrarily large distances. A method for determination of the ordering energy for various coordination spheres from the experimental distribution of the background intensity is indicated. Anomalously high diffuse scattering near points of phase transitions of the second order and critical points on the decay curve is considered. A.

539.234

2680. ON THE QUESTION OF THE STRUCTURE AND PROPERTIES OF LAYERS OBTAINED BY THE EVAPORATION OF InSb IN VACUUM. P.A.Kurov.
Zh. tekh. Fiz., Vol. 27, No. 9, 2181-2 (1957). In Russian.

The claim by Konozenko and Mikhnovskii (Izv. Akad. Nauk, Ser. fiz., Vol. 20, No. 12, 1486, 1956) to have obtained layers of InSb by evaporation of InSb in vacuum is examined. On the basis of their electron diffraction photographs, and of his own and other work, Kurov concludes that they were dealing with films of Sb, which were amorphous when deposited but became crystalline and metallic when heated. It is pointed out that InSb layers can be obtained by the simultaneous evaporation of In and Sb (Abstr. 9181/1957). K.F.Hulme

539.27

2681. SOME CARBON REPLICA TECHNIQUES FOR THE ELECTRON MICROSCOPY OF SMALL SPECIMENS AND FIBRES. B.J.Spit; D.E.Bradley.
Brit. J. appl. Phys., Vol. 8, No. 12, 493 (Dec., 1957).

A criticism of Bradley's paper on the same topic (Abstr. 7454/1957). The author claims that Bradley's work represents no advance on previously published work of the same nature, in particular that of Dlugosz.

Bradley replies. J.Thewlis

539.27

2682. CONTRAST IN THE ELECTRON MICROSCOPE IMAGE. R.C.Valentine.
Nature (London), Vol. 181, 832-3 (March 22, 1958).

The detail seen in contemporary electron microscopes is limited more by contrast than by resolving power. A recent theoretical treatment by Zeitler and Bahr (Experimental Cell Research, Vol. 12, 44, 1957) enables an estimate to be made of the increase in contrast that is possible by "staining" the specimen with atoms of a heavy metal. This theory leads to the conclusion that for a specimen of given thickness the percentage intake of staining material is independent of the nature of the stain used. On the other hand it is not yet clear whether the observed contrast in stained specimens arises from an entirely different mechanism, for example the non-uniform distribution of the staining material in the specimen. T.Mulvey

ELASTICITY. STRENGTH. RHEOLOGY

539.313 : 548.0

2683. NEW DERIVATION OF ELASTIC EQUATIONS FOR TRIGONAL HOLOAXIAL CRYSTALS. K.Miyakawa.
Phys. Rev., Vol. 107, No. 3, 677-82 (Aug. 1, 1957).

A new derivation of elastic equations is proposed, based upon potential energy due to interaction between unit cells in a crystal. The theory is fully developed for the holoaxial class of crystal symmetry. The theory does not require the assumptions that are used in the conventional derivation. Instead, it is shown that a simple translation and a rigid body rotation have no effect on the conventional equations. The derivation achieves two objectives: first, it gives, in a more satisfactory fashion, physical meaning to each term in the differential equations; secondly, it provides a general relationship between macroscopic and intermolecular forces. The difficulty of interpreting the nature of the forces acting in the conventional equations is resolved. In addition to the central force, it is found necessary to have a new force, acting in a direction perpendicular to the direction of the central force. It is further found that the forces have centroidal symmetry, in addition to the spherical and trigonal holoaxial symmetries. If only central forces are assumed, the Cauchy relations are easily obtained. A.

539.32 : 551.312.12

2684. THE ELASTIC PROPERTIES OF ICE AND METHODS OF STUDYING THEM. E.M.Lin'kov.
Vestnik Leningrad. Univ. Ser. Fiz. Khim. No. 3 (1957) No. 16, 58-68. In Russian.

Results obtained by measuring the elastic moduli of ice are

compared for static, resonance, ultrasonic and seismic methods. It is pointed out that the influence of meteorological conditions on the elastic properties has not yet been sufficiently studied.

C.R.S.Manders

539.32

2685. ELASTIC MODULI OF SINGLE CRYSTAL GERMANIUM AS A FUNCTION OF HYDROSTATIC PRESSURE. H.J.McSkimin.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 314-18 (April, 1958).

The adiabatic elastic moduli of single crystal germanium are reported as a function of hydrostatic pressure to 50 000 lb/in^2, and for a temperature range of 0-75°C. The variation with pressure of bulk modulus is found to compare favourably with isothermal values obtained by Bridgman. The techniques used for measurement are detailed. A.

539.32

2686. INTERNAL FRICTION IN ALUMINUM AT LOW TEMPERATURES. A.J.Filmer, G.J.Hutton and T.S.Hutchison.
J. appl. Phys., Vol. 29, No. 2, 146-8 (Feb., 1958).

Preliminary measurements at 40 kc/s of the internal friction of 99.992% aluminium as a function of temperature yield a number of attenuation maxima at temperatures between 90° K and 300° K. These maxima are unlike the cold-worked induced peaks, first reported by Bordoni. They appear to be of two types, a broad maximum at about 225° K and a series of very sharp peaks at lower temperatures. The latter are tentatively associated with the break-away of dislocations from minor pinning points. A.

539.373

2687. SLIP OF ZINC AND CADMIUM WHISKERS.
R.V.Coleman, B.Price and N.Cabrera.
J. appl. Phys., Vol. 28, No. 11, 1360-1 (Nov., 1957).

Tensile tests were made on Zn and Cd whiskers (1-10 μ). Initial linear elastic strain of 1-2% was always observed, and computed elastic moduli were always smaller than accepted value by factor of about 0.7. Investigation of effect of temperature showed slip in Cd above 20° K and in Zn above 160° K. Critical shear stress was several 100 times that observed in macroscopic crystals. Whole crystal yields at force roughly 30 times smaller than that required to initiate slip. When slip has extended throughout crystal the force must be doubled to cause further yielding suggesting some work hardening due to the initial slip. It is concluded crystals are not perfect and dislocations have to move through considerable concentration of obstacles, although nature of obstacles is not yet clear. J.W.Menter

539.374

2688. THE TEMPERATURE DEPENDENCE OF FLOW STRESS IN COPPER SINGLE CRYSTALS. M.J.Makin.
Phil. Mag. (Eighth Ser.), Vol. 3, 309-11 (March, 1958).

Cu single crystals of a standard crystal orientation were subjected to tensile tests at various temperatures between −195°C and +196°C. The ratios of the flow stresses at different temperatures (constant above 10% elongation) are plotted against temperature, after correcting for the change in elastic constants with temperature and for the yield point produced by unloading (Abstr. 2041/1958). The corrected flowstress is only slightly dependent on temperature, except for a step in the curve, representing a decrease of about 1.7%, observed between −39°C and −57°C. J.G.Oldroyd

539.375

2689. EXPERIMENTS ON CONTROLLED FRACTURES.
N.L.Svensson.
Proc. Phys. Soc., Vol. 71, Pt 1, 136-8 (Jan., 1958).

The strain energy of a beam subjected to shearing forces is the sum of the energy due to flexure and shearing stresses. A parabolic distribution of shearing stress over the depth of the beam is assumed and the total strain energy is computed. It shows that the introduction of the shear stress increases the strain energy and that this gives better correlation between theory and experimental data in the case of certain plastic materials such as polystyrene and polymethylmethacrylate. A.C.Whiffin

539.42

2690. A THEORY OF THE FRACTURE OF METALS. A.N.Stroh.
Advances in Phys., Vol. 6, 418-65 (Oct., 1957).

Deals mainly with the transcrystalline fracture of polycrystalline materials, an attempt being made to show how the principal features observed follow a simple model. The failure of single crystals, fatigue failure and creep are not dealt with. The two main types of fracture considered are (1) brittle fracture with little plastic deformation and (2) considerable plastic deformation before failure. Orowan's theory is used to show how the interatomic forces depend on distance between them and to deduce the strength of the ideal lattice, and this is followed by Griffith's theory of cracks which act as stress concentrators to reduce the strength of the ideal material. In discussing brittle fracture of metals, consideration is given to piled up groups of dislocations and it is shown that the stress to initiate a crack is that which will bring two leading dislocations of the piled up group within an atomic spacing of each other. The conditions determining the transition from brittleness to ductility are also considered, and relations between the temperature at which this transition occurs and rate of strain are deduced. It is deduced that the limiting velocity of propagation of a Griffith type of crack is the velocity of Rayleigh or surface waves in the material. A.C.Whiffin

539.43

2691. METAL FATIGUE. N.Thompson and N.J.Wadsworth.
Advances in Phys., Vol. 7, 72-170 (Jan., 1958).

The current position is reviewed in regard to some of the basic problems of the fatigue of metals. Pt I explains some of the terms used in this work and describes the common experimental techniques. The effects resulting from trace elements, surface finish, environment, and temperature are described. Pt II summarizes some of the very large number of experimental results, dealing with the S-N form of curve, metallographic examination of slip under alternating stress, particularly in single crystals. Slip has been encountered at stresses well below the fatigue limit, and specimens stressed just below the limit do not have a different surface appearance from those stressed just above it. Cracks grow slowly in pure metals and pits in slip planes have been observed at very low stresses. The extrusion of slip bands is described, together with the hardening processes resulting from fatigue. Descriptions are given of the effect of notches on fatigue failure and the propagation of cracks. Pt III discusses some of the current ideas on the interpretation of the results. A.C.Whiffin

539.434

2692. ON CREEP AND RELAXATION.
I.L.Hopkins and R.W.Hamming.
J. appl. Phys., Vol. 28, No. 8, 906-9 (Aug., 1957).

The creep function for the National Bureau of Standards polyisobutylene at 25°C is calculated from the relaxation function, using the integral equation connecting them. The calculated function is shown to be correct in its initial slope, to satisfy the inequality $\varphi(t)\psi(t) \leq 1$ throughout, and to approach satisfactorily the independently determined asymptote. A.

539.576

2693. NOTE ON THE WEAR OF TEFLON SLIDING ON TEFLON.
D.G.Flom.
J. appl. Phys., Vol. 28, No. 11, 1361-2 (Nov., 1957).

Wear experiments with cylindrical and hemispherical sliders show independence of speed for speeds used (189 cm/sec and 95 cm/sec) and rate varying as 4/3 power of sliding distance.

J.W.Menter

539.6

2694. MEASUREMENT OF THE MOLECULAR ATTRACTION BETWEEN DIFFERENT TYPES OF SOLID BODIES. I.I.Abrikosova.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 799-801 (1957). In Russian.

Experimental data are given for the attractive force and surface energy against the gap between surfaces of fused quartz. These agree with theory and with other experimental work done in a different way.

S.F.Edwards

539.621

2695. THE INTRINSIC VARIABLES AFFECTING THE STICK–SLIP PROCESS. E.Rabinowicz.
Proc. Phys. Soc., Vol. 71, Pt 4, 668-75 (April, 1958).

Stick–slip oscillations of two sliding surfaces are normally analysed in terms of the kinetic friction-velocity and the static friction-time of stick characteristics of the rubbing surfaces. It is shown that, in addition, a critical distance, of the order of 10^{-3} cm, enters into the calculations, being the minimum resolving power of the friction process. Stick–slip oscillations must normally have an amplitude greater than the critical distance, and thus increased spring stiffness is often effective in eliminating stick–slip. Using the critical distance concept, it is possible to deduce a simple relationship between the static and kinetic coefficients of friction, and this is confirmed by experimental data. A.

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM. CHEMICAL REACTIONS

541.127

2696. IMPROVED METHOD OF CALCULATING REACTION RATE CONSTANTS FOR FREE RADICALS. R.F.Sweeny.
J. chem. Phys., Vol. 27, No. 4, 987-8 (Oct., 1957).

A non-linear pressure drop relation is developed to determine the time required for the gas to flow from the free radical source to the lead mirror in a lead tetramethyl and carbon monoxide reaction. Results are compared with those obtained by assuming a linear pressure drop (Paneth's) equation. W.Good

541.127 : 539.14

2697. REACTION RATES BY NUCLEAR MAGNETIC RESONANCE. H.M.McConnell.
J. chem. Phys., Vol. 28, No. 3, 430-1 (March, 1958).

The Bloch equations for nuclear magnetic resonance are modified to describe the magnetic resonance of a single nuclear species X which is transferred back and forth between two (or more) magnetic environments (A,B) by kinetic molecular processes. The modified Bloch equations involve the usual assumptions of the Bloch theory and, in addition, require (a) that the X nuclear relaxation times be independent of the molecular exchange rates, and (b) that the X nuclear magnetization in A relax independently of the X magnetization in B, and vice versa. The modified Bloch equations are easily solved in the slow passage case, with arbitrary r.f. saturation. Earlier relations between reaction rates, and resonance line shapes, which were developed by Gutowsky, McCall, and Slichter, and extended by a number of other investigators, are easily derived using the modified Bloch equations. In the present work the modified equations are used to show how rapid exchange rates can sometimes be measured in solutions where the X relaxation times are relatively long in one system, A, and short in the second, B. A.

PHOTOCHEMISTRY. RADIATION CHEMISTRY

541.15

2698. WATER DECOMPOSITION YIELDS IN THE RADIOLYSIS OF AQUEOUS FORMIC ACID-OXYGEN SOLUTIONS BY CYCLOTRON-PRODUCED RADIATIONS. W.M.Garrison, B.M.Weeks, J.O.Ward and W.Bennett.
J. chem. Phys., Vol. 27, No. 5, 1214-15 (Nov., 1957).

Formic acid solutions saturated with 1 atm of oxygen were exposed to a beam of 10 MeV protons or to neutrons generated by 24 MeV deuterons in a beryllium target. The CO_2 formed was measured radiometrically by using $HC^{14}OOH$ and the H_2O_2 formed was titrated with ceric sulphate. From these data the G value for the reactions (1) $H_2O = H + OH$, and (2) $H_2O = \frac{1}{2}H_2 + \frac{1}{2}H_2O_2$ were calculated. For 10 MeV protons $G(1) = 2.39 \pm 0.05$ and $G(2) = 1.26 \pm 0.18$. For neutrons the absolute values are not known, but the ratio of $G(1)/G(2) = 2.73 \pm 0.10$. M.Ebert

541.15

2699. RADIATION CHEMISTRY OF SOLID PARAFFINS A.I.Snow and H.C.Moyer.
J. chem. Phys., Vol. 27, No. 5, 1222-3 (Nov., 1957).

Straight-chain paraffins C_{30}-C_{31} with C_{28} and C_{27} predominating were irradiated in a nitrogen atmosphere to doses up to 970×10^6 r using spent nuclear reactor fuel as a radiation source. The samples were analysed by distillation, acetone extraction, urea adduction and iodine number measurements for polymer and double-bond formation. Unsaturation per monomer unit was found to be much greater in the polymer than in the monomer. It shows a limiting value found by extrapolation of 0.36 double bonds per monomer unit of 27 C for zero dose. The formation of a free radical of the allylic type by hydrogen abstraction in the alpha position from a previously formed olefin is postulated to explain the results. This suggests that olefins are directly involved in the crosslinking process. M.Ebert

541.15

2700. ISOTOPIC TECHNIQUES IN THE STUDY OF THE SONOCHEMICAL FORMATION OF HYDROGEN PEROXIDE. M.Del Duca, E.Yeager, M.O.Davies and F.Hovorka.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 301-7 (April, 1958).

Isotopic techniques involving oxygen-18 were used to study the processes involved in the sonochemical formation of hydrogen peroxide during cavitation in oxygen-saturated solutions. Both tracer and equilbration experiments were carried out in an all glass system with converging ultrasonic fields providing maximum intensities of $10^3 W/cm^2$ at frequencies of 600 and 800 kc/s. In oxygen-saturated water, one-third of the hydrogen peroxide oxygen was found to be derived from the oxygen gas while in solutions containing 30% (by volume) methanol, all of the peroxide oxygen was derived from the oxygen gas. In both cases, the oxygen molecule appears to be incorporated as a unit in one peroxide molecule without formal cleavage of the O—O bond. Conditions associated with ultrasonically produced cavitation appear sufficient to dissociate water into H and OH and to rupture the C—H bond in organic molecules such as methanol but not sufficient to dissociate molecular oxygen. The oxygen molecule is involved in secondary reactions with hydrogen atoms, and hence, contributes to the formation of hydrogen peroxide. The experimental results can be explained most readily in terms of the large temperature rises which are presumed to occur within cavitation during compression but do not exclude electrical phenomena within the cavitation bubbles as a possible mechanism for the dissociation processes. A.

CHEMICAL ANALYSIS

545.71

2701. PRECISION THERMAL-CONDUCTIVITY GAS ANALYZER USING THERMISTORS. R.E.Walker and A.A.Westenberg.
Rev. sci. Instrum., Vol. 28, No. 10, 789-92 (Oct., 1957).

The characteristics of a thermal conductivity gas-analyser unit employing thermistors as sensing elements are analysed theoretically. It is shown that, as a consequence of the fact that thermistors have a negative temperature coefficient of resistance, the sensitivity of the instrument as a function of bridge current exhibits a maximum. The dependence of zero stability on current and cell temperature is approximately related to differences in resistance, temperature coefficient of resistance, and geometry of the reference and sample thermistors. An apparatus suitable for precise trace analyses is described and results obtained with it are presented. It is suggested that the widespread lack of faith in the inherent stability of thermistors for analysis applications is not justified, and has probably been due to insufficient care with current and temperature control. A.

545.71

2702. SONIC GAS ANALYZER FOR MEASUREMENT OF CO_2 IN EXPIRED AIR. F.D.Stott.
Rev. sci. Instrum., Vol. 28, No. 11, 914-15 (Nov., 1957),

A sonic gas analyser intended primarily for estimation of CO_2 in the physiological range of 0-10% is described. The instrument uses a resonant cavity maintained in oscillation by a transistor amplifier as the measuring device; the change in frequency caused by the presence of CO_2 in the cavity is linearly related to the amount of CO_2 present. As described the instrument is intended for continuous sampling at a rate of about 2 litres/min. The time of response is about 0.5 sec for full deflection. A.

CRYSTALLOGRAPHY

548.5

2703. ZINC AND CADMIUM WHISKERS.
R.V.Coleman and N.Cabrera.
J. appl. Phys., Vol. 28, No. 11, 1360 (Nov., 1957).

Zn and Cd whiskers grown from vapour in atmosphere of He obtained by evaporating liquid He show no appreciable differences in properties from those grown in He, A, Kr containing 1 part in 10^6 N_2. All straight whiskers had axes in (10$\bar{1}$0) plane, often forming an angle $\theta = 30^\circ$ with c axis. Two side faces are prismatic and the other four (01$\bar{1}$1). No twisting was observed. Thin hexagonal Zn plates are sometimes observed to grow sideways from whisker. Plasticity of whiskers shows they contain many dislocations. Plate growth can be understood in terms of growth from dislocations terminating on lateral faces. It is suggested whiskers may grow straight because most dislocations terminating on lateral faces have Burgers vectors parallel to surface. J.W.Menter

548.55

2704. METHOD FOR GROWING SINGLE CRYSTALS OF POTASSIUM NIOBATE. C.E.Miller.
J. appl. Phys., Vol. 29, No. 2, 233-4 (Feb., 1958).

The crystals were grown on a potassium niobate seed rotated in a mixture of 0.12 mole K_2CO_3 and 0.10 mole Nb_2O_5 at 1070° C. Growth was maintained by lowering the temperature at 3 deg C/hr, and crystals up to 15 g weight were produced in an 8 hr run. A full account of the method is given, but there are no details of the twinning or electrical quality of the resulting crystals.
L.E.Cross

548.574

2705. EFFECT OF OXYGEN ON ETCH-PIT FORMATION IN SILICON. R.A.Logan and A.J.Peters.
J. appl. Phys., Vol. 28, No. 12, 1419-23 (Dec., 1957).

The etching behaviour of as-grown and heat-treated silicon crystals was studied using an etching procedure developed by Dash. The rate of chemical etching of silicon was found to decrease with increased concentration of dissolved oxygen. This effect impedes the formation of etch-pits. To explain the observed etching behaviour after heat treatment it is necessary to assume that the rate of chemical etching increases with increased amount of precipitated oxygen in pulled crystals. A.

X-RAY CRYSTALLOGRAPHY

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.736.4 : 539.219

CRYSTAL STRUCTURE OF PbS, PbSe AND PbTe SOLID SOLUTIONS. See Abstr. 2678.

548.74 : 539.27

2706. ELECTRON MICROSCOPIC OBSERVATION OF PERIODIC STRUCTURES BELOW 10 A. G.A.Bassett and J.W.Menter.
Phil. Mag. (Eighth Ser.), Vol. 2, 1482-4 (Dec., 1957).

Electron micrographs have been obtained showing the (020) spacing (6.9 A) resolved in crystals of molybdenum trioxide. The authors believe that it should be possible to resolve lattices with spacings down to 5 A at least. J.W.Menter

548.74 : 539.18

NOTE ON THE ATOM FORM FACTOR. See Abstr. 2598

GEOPHYSICS

550.38.08 : 621.317.444

2707. A THREE-COMPONENT AIRBORNE MAGNETOMETER.
P.H.Serson, S.Z.Mack and K.Whitham.
Publ. Dominion Obs. Ottawa, Vol. 19, No. 2, 15-97 (1957).

The magnetometer described contains three orthogonal magnetic detectors of the saturated transformer type. It is mechanically linked to a gyro-stabilized platform which is maintained horizontal. The system acts basically as a pendulum with a six-minute period, and the accuracy of the platform is 2 or 3 minutes of arc under normal survey conditions. Signals from the magnetometer are fed into an analogue computer which displays continuously the declination in degrees and the horizontal and vertical field components in gauss. The accuracy of measurements is estimated to be $\pm 0.1^\circ$ in declination and 20 gamma in the other components. Sources of error in survey operations are discussed and it is concluded that the probable error of a survey observation as plotted on a chart is about 100 gamma in any component and is principally due to errors in navigation and plotting. A.E.De Barr

550.384

2708. SOME OBSERVATIONS OF GEOMAGNETIC MICROPULSATIONS. H.J.Duffus and J.A.Shand.
Canad. J. Phys., Vol. 36, No. 4, 508-26 (April, 1958).

New observations are reported of the diurnal variation, direction, frequency spectrum, and geographical distribution of geomagnetic micropulsations (Pc and Pt). It is argued from a comparison of published data that these phenomena have primarily a solar time dependence, and may occur locally. At the two stations, separated by 60 longitude degrees, related signals were only occasionally observed. The phase characteristics of such related signals, together with differences in directional characteristics reported by other observatories, put serious strain on recent theories of the outer atmospheric origin of micropulsations. A.

551.463 : 535.43.07

SUBMARINE NEPHELOMETER. See Abstr. 2260

ATMOSPHERE. METEOROLOGY

551.508.71

2709. RECORDING MICROWAVE HYGROMETER.
J.B.Magee and C.M.Crain.
Rev. sci. Instrum., Vol. 29, No. 1, 51-4 (Jan., 1958).

Describes a rapid response microwave hygrometer for continuously recording the water vapour pressure of atmospheric air over a wide ambient range. The principle employed involves the measurement by means of a cavity resonator of the contribution of water vapour to the refractive index of atmospheric air. The device described also has potential application to the continuous measurement of the degree of contamination of one gas (or of gas mixtures) by another gas (or gases). A.

551.508.8

2710. RESPONSE OF RADIOSONDE THERMISTORS.
F.I.Badgley.
Rev. sci. Instrum., Vol. 28, No. 12, 1079-84 (Dec., 1957).

The lag coefficient of a thermometer of cylindrical shape is shown to be approximately proportional to the one-half power of its diameter and inversely proportional to the one-half power of the product of ventilation speed and density of the environmental air. This leads to estimated lag coefficients of the order of twenty-five seconds for radiosonde thermistors near their useful ceiling which in turn implies that radiation errors of one to several degrees may be expected in radiosonde temperature measurements at high altitudes. A.

551.510.535 : 523.745

R.F. PROPAGATION IN IONOSPHERE AND SOLAR ACTIVITY. See Abstr. 2104

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.521.3 : 523.78

2711. CHANGES IN THE COEFFICIENT OF TRANSPARENCY OF THE ATMOSPHERE DURING THE TOTAL SOLAR ECLIPSE ON 30TH JUNE 1954. B.D.Fomenko.
Astron. Zh., Vol. 34, No. 6, 868-82 (1957). In Russian with summary in English.

Measurements are reported between 2900 A and 20 000 A. An estimate is made of the effect of water vapour on the coefficient of transparency and of changes in the thickness of the ozone layer during the eclipse. S.Chomet

551.574.1

2712. ELECTRIC CHARGES ON CONDENSATION NUCLEI WHEN WATER VAPOUR IS ABSORBED OR GIVEN OFF. R.Mühleisen.
Naturwissenschaften, Vol. 45, No. 2, 34-5 (1958). In German.

Experimental results show that when the water vapour content of the air in a large hall of volume 400 m^3 was increased, there existed a negative space charge of about 1000 elementary charges per cm^3. Heating the air caused the space charge to become a positive one of about the same magnitude. These results and their relation to meteorological observations, such as the morning increase in the fine-weather field, are briefly discussed. J.Dutton

551.593.53

2713. QUALITATIVE INDICATION OF NADIR SKY BLUE. R.B.Toolin and V.J.Stakutis.
J. Opt. Soc. Amer., Vol. 48, No. 1, 71-2 (Jan., 1958).

Results of photographing spectra of nadir skylight with a balloon-borne Littrow spectrograph at a series of different-altitudes, and over differing terrestrial terrain, are tabulated. Large increases of light flux (with altitude) in the violet and blue spectral regions, with much smaller increments in the red, afford a qualitative demonstration of the increasingly blue-violet haze with altitude as seen by an airborne observer. Between 4000 and 86 000 ft a nearly 6-fold gain in the violet-to-red flux ratio is found. D.R.Barber

551.594.21 : 621.396.9

2714. THE MEASUREMENT OF WORLD-WIDE THUNDERSTORM ACTIVITY AT A SINGLE LOCALITY. G.A.Isted.
Marconi Rev., Vol. 20, 130-2 (4th Qtr, 1957).

Confirmation of the author's suggestion (Abstr. 6646/1955) that measurements of the diurnal variation of world-wide thunderstorm activity can be made by counting the electrical impulse disturbances observed in the kc/s band at a single station (Great Baddow) is obtained from similar measurements in the 25-130 c/s band by Holzer and Deal in California (Abstr. 5567/1956) for the same period. The diurnal variations plotted against Universal Time show striking agreement, and appear to confirm that such measurements reflect the variation of the vertical electric field over the earth,which is believed to be maintained by the world-wide thunderstorm activity. G.M.Brown

BIOLOGY

MEDICAL SCIENCE. HUMAN PHYSIOLOGY

612.17 : 534.4

2715. ON INTRACARDIAC PRESSURE MEASUREMENT. A.K.Oppenheim.
J. Acoust. Soc. Amer., Vol. 29, No. 10, 1144 (Oct., 1957).

Comment is made on a pressure gauge described by Wallace, Brown, Lewis and Deitz (Abstr. 4925/1957), and attention is drawn to a long series of papers on the same topic by Warburg and Tybjaerg Hansen. Full references are given. C.B.Allsopp

612.18 : 621.65 : 578

2716. NONMAGNETIC, VIBRATIONLESS, CONSTANT DELIVERY PUMP FOR BIOLOGICAL SOLUTIONS. A.S.Brill, H. den Hartog and V.Legallais.
Rev. sci. Instrum., Vol. 29, No. 3, 242-3 (March, 1958).

A pump is described which utilizes the Bellofram, a hat-shaped rubber diaphragm, as a seal between a piston and cylinder of Plexiglas. These pumps are used in a gravity-driven flow system which is completely nonmagnetic and vibrationless, and produces flow rates constant with ± 2%. The pumps are also used with a synchronous motor drive which produces flow rates constant within ± 1%. The motor drive makes small but observable magnetic and vibrational disturbances. A.

612.721

2717. AXIOMATICS OF BINOCULAR VISION. THE FOUNDATIONS OF METRIC GEOMETRY IN RELATION TO SPACE PERCEPTION. A.A.Blank.
J. Opt. Soc. Amer., Vol. 48, No. 5, 328-34 (May, 1958).

The theory of binocular vision is given a foundation in the empirically defined relations of length-ordering and alignment. The development differs significantly from earlier presentations in not requiring the presupposition of numerical metric relations, but shows instead how quantitative metric properties may be derived from the most elemental nonquantitative observations of visual experience. The requirements that the axioms reflect direct visual experience results in a development of the foundations of metric geometry which is unconventional in that topological assumptions and assumptions as to the prolongation of segments are proscribed. A.

612.843.32

2718. DEPENDENCE OF LUMINANCE REQUIRED FOR CONSTANT BRIGHTNESS UPON CHROMATICITY AND CHROMATIC ADAPTATION. E.J.Breneman.
J. Opt. Soc. Amer., Vol. 48, No. 4, 228-32 (April, 1958).

Heterochromatic brightness matches were made between each of a variety of colours and a standard of approximately daylight quality. A binocular colorimeter was used with the field subtending an angle of 1°50'. A modification of this colorimeter permits alternate presentation of adapting stimuli for nine seconds and test stimuli for one second. Four adapting colours, white (approximately daylight), red, green, and blue, were used. For each adapting colour, a surround of approximately the same colour and subtending an angle of 10° or more was used. The results show that, for adaptation to daylight, blues and saturated reds generally have less luminance than a neutral standard of the same brightness, while greens and yellows have luminances nearly equal to, or greater than, that of the standard. This is in general agreement with the results of previous investigations. For most test colours, adaptation to a saturated red results in greater luminance being required to match the daylight standard than was required with white adaptation. This is true even for colours complementary to the red-adapting stimulus. Adaptations to blue and green modify the luminance ratios to a lesser extent. A.

612.85

2719. IMPROVED CUSHION FOR EAR DEFENDERS. E.A.G.Shaw and G.J.Thiessen.
J. Acoust. Soc. Amer., Vol. 30, No. 1, 24-36 (Jan., 1958).

Circumaural ear defenders require a cushion which is highly adaptable to the irregular contours of the head so as to provide a good air seal, and yet behaves like a stiff spring so as to minimize low-frequency cup vibration. These apparently contradictory requirements are met by a cushion consisting of an annulus of highly flexible yet rather inextensible material partially filled with an incompressible fluid. A theory of cushion behaviour is given and is supported by experimental data. Experiments with real heads show that the attainable low-frequency attenuation is limited by the viscoelastic properties of the flesh. Values of circumaural flesh impedance derived from the experimental data are compared with the mastoid data of other workers, and the relationship between sound transmission and threshold shift data is discussed. The design of a rigid cup and flexible frame suitable for use with the cushion is also discussed. A.

612.858.6

2720. ENDOLYMPHATIC OXYGEN TENSION IN THE COCHLEA OF THE GUINEA PIG.
G.A.Misrahy, K.M.Hildreth, E.W.Shinabarger, L.C.Clark and E.A.Rice
J. Acoust. Soc. Amer., Vol. 30, No. 4, 247-50 (April, 1958).

Oxygen tension of the endolymph in the scala media of the guinea pig cochlea was measured using a micropolarographic technique. Near the stria vascularis the oxygen tension was 55 to 70 mm Hg. Deeper in the scala media it decreased gradually to 16 to 25 mm Hg. Effects of sound, hypoxia, hyperoxia, and hypercapnea were studied. Oxygen tension decreased with hypoxia and sound, and it increased with hyperoxia and hypercapnea. A technique to check the integrity of a metallic-plated microelectrode is described. A.

612.858.71

2721. TEMPORARY THRESHOLD SHIFT AS A FUNCTION OF NOISE EXPOSURE LEVEL. W.J.Trittipoe.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 250-3 (April, 1958).

Under special conditions, numerous investigators have observed that, when duration of exposure is held constant, a greater temporary threshold shift (T.T.S.) may occur after exposure to a lower sound level than after exposure to a higher sound level. However at least after a short recovery interval, it would be reasonable to expect that T.T.S. following exposure to higher sound levels would be an increasing function of the exposure level. In the present study T.T.S. was measured continuously with a Békésy-type audiometer at 4000 and 6000 c/s for 10 min following a 3 min exposure to a thermal noise. Five different noise levels, ranging in 5 dB steps from 108 to 128 dB in S.P.L. were used. Among nine ears tested, twice on each condition, only one ear showed a pattern of decreasing T.T.S. with an increased noise exposure level at both measuring frequencies. A.

612.858.71

2722. ON THE EFFECT OF PRACTICE AND MOTIVATION ON THE THRESHOLD OF AUDIBILITY.
J.Zwislocki, F.Maire, A.S.Feldman and H.Rubin.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 254-62 (April, 1958).

The thresholds of audibility for 100 and for 1000 c/s were measured on five groups of originally naive listeners by various experimental techniques. All the experiments showed improvement of the threshold with practice. The improvement was greater at 100 c/s than at 1000 c/s. Pretraining at 1000 c/s did not affect the threshold change at 100 c/s. The improvement of the threshold with practice was enhanced considerably by reward and feedback. A.

612.858.75

2723. ON THE MINIMUM AUDIBLE ANGLE. A.W.Mills.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 237-46 (April, 1958).

The difference limen for the azimuth of a source of pure tones was measured as a function of the frequency of the tone and the direction of the source. Tone pulses between 250 and 10 000 c/s were sounded in the horizontal plane around the head of a subject seated in an anechoic chamber. The smallest angular separation that can be detected between the sources of two successive tone pulses (the minimum audible angle) was determined for each of three subjects. These threshold angles are analysed in terms of the corresponding threshold changes in the phase, time, and intensity of the tone at the ears of the subject. A comparison of these thresholds with those reported for dichotic stimulation indicates that the resolution of the direction of a source is determined, at frequencies below about 1400 c/s, by interaural differences in phase or time, and at higher frequencies by differences in intensity. When the conditions are optimal for temporal discrimination, the threshold for an interaural difference in time is about 10 μsec, and when the conditions are optimal for intensity discrimination, the threshold for an interaural difference in intensity is about 0.5 dB. A.

621.65 : 578 : 612.18

NONMAGNETIC, VIBRATIONLESS, CONSTANT DELIVERY PUMP FOR BIOLOGICAL SOLUTIONS. See Abstr. 2716

TECHNIQUE. MATERIALS

66.06/.07

2724. METAL SYSTEM FOR CHEMICAL REACTIONS AND FOR STUDYING PROPERTIES OF GASES AND LIQUIDS.
H.V.Neher and S.Prakash.
Rev. sci. Instrum., Vol. 28, No. 4, 267-70 (April, 1957).

An all-metal system, made of copper, is described. It is suitable for working with those chemicals which do not attack copper. In particular it has been found very useful in the purification of BF_3 and $B(CH_3)_3$. Some important features of such a system are: (1) a complete absence of contaminants; (2) reactions may be carried out up to 500°C; (3) pressures up to several hundred pounds per square inch may be used; (4) flow of gases from very low to very high pressures may be easily controlled; (5) the system is very rugged. This latter point is particularly desirable where noxious or inflammable gases (such as $B(CH_3)_3$) are used. A method is also described whereby gases from sealed-off containers under either high or low pressures may be easily retrieved without introducing impurities. Other important advantages of such a system are mentioned. A.

669.054 : 621.318.381

2725. THE USE OF ELECTROMAGNETIC STIRRING IN ZONE REFINING. J.B.Mullin and K.F.Hulme.
J. Electronics and Control, Vol. 4, No. 2, 170-4 (Feb., 1958).

It is shown that the optimum removal of an impurity during zone refining may be achieved even at high rates of traverse by the use of stirring in the molten zone produced by a magnetic field rotating at 400 c/s. A.

PHOTOGRAPHY

771.534.3

2726. ENERGY TRANSFERS BETWEEN CRYSTALS AND ADSORBED DYES. I. DESENSITIZATION. R.C.Nelson.
J. Opt. Soc. Amer., Vol. 48, No. 1, 1-3 (Jan., 1958).

The electron affinities of several desensitizing dyes were measured and found to lie in the neighbourhood of 3.5 eV, and it seems unlikely that the dye can compete with sensitivity specks for electrons at equilibrium. The dyes produced a desensitization of photoconductivity in cadmium sulphide films, indicating that they can serve as surface electron traps. A mechanism of desensitization is suggested according to which the photoelectrons are loosely bound by one or several dye molecules seriatim, in consequence of which their times of arrival at the sensitivity speck are spread out over a long enough period so that the factors which contribute to the instability of the latent image become effective, and the sensitivity is thereby reduced. A.

LIST OF JOURNALS

The following list supplements the List of Journals published with the June number of Volume 60 (1957) and the Supplement published with the Index to the same volume. Reprints of the List of Journals and of the Supplement can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Bull. Acad. Polon. Sci. Sér. Sci. math. astron. phys.	Bulletin de l'Académie Polonaise des Sciences. Série des Sciences Mathématiques, Astronomiques et Physiques. Formerly: Classe Quatriéme. Polish Academy of Sciences, Distribution Centre for Scientific Publications, Pałac Kultury i Nauki, Warsaw.
Bull. Acad. Polon. Sci. Sér. Sci. tech.	Bulletin de l'Académie Polonaise des Sciences. Série des Sciences Techniques. Formerly: Classe Troisième. Polish Academy of Sciences, Distribution Centre for Scientific Publications, Pałac Kultury i Nauki, Warsaw.
E.B.U. Rev. A	E.B.U. Review, Part A - Technical. Technical Centre of the European Broadcasting Union, 4 rue de la Vallée, Brussels.
Fortschr. Phys.	Fortschritte der Physik. Publication addresses: Akademie-Verlag, Mohrenstrasse 39, Berlin, W.8; Kunst und Wissen, Hospitalstrasse 33a, Stuttgart-N; Foreign orders to: Deutschen Buch-Export und -Import, Postschliessfach 276, Leipzig, C.1.
Konstruktion	Konstruktion. Springer-Verlag, Berlin/Göttingen/Heidelberg.
Schweiz. tech. Z. (S.T.Z.)	Schweizerische Technische Zeitschrift (STZ) = Revue Technique Suisse = Revista Tecnica Svizzera. Gotthardtstr. 61, Zürich 27.
Smithsonian Contrib. Astrophys.	Smithsonian Contributions to Astrophysics. Smithsonian Institution, Washington, D.C. Obtainable from: Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

NEW JOURNALS

Geophys. J.	Geophysical Journal of the Royal Astronomical Society (incorporating the Geophysical Supplement to the Monthly Notices of the Royal Astronomical Society). Royal Astronomical Society, Burlington House, London, W.1. Quarterly. Vol. 1, No. 1 dated March, 1958.
Molecular Phys.	Molecular Physics. Taylor and Francis, Red Lion Court, Fleet Street, London, E.C.4. Quarterly. Vol. 1, No. 1 dated Jan., 1958.
Pakistan J. sci. industr. Res.	Pakistan Journal of Scientific and Industrial Research. Pakistan Council of Scientific and Industrial Research, No. 3/4/D/IV, Nazimabad, Karachi. Quarterly, but to be developed into a monthly journal as soon as possible. Vol. 1, No. 1 dated Jan., 1958.
Phys. Fluids	Physics of Fluids. American Institute of Physics, 335 East 45th Street, New York 17, N.Y. Bi-monthly. Vol. 1, No. 1 dated Jan.-Feb., 1958.

NOTES

Bull. Acad. Polon. Sci. Cl. III and Cl. IV	Bulletin de l'Académie des Sciences, Classe Troisième et Classe Quatrième. From Vol. 6 (1958) the title of this journal is altered as follows: "Classe Troisième" becomes "Série des Sciences Techniques" "Classe Quatrième" becomes "Série des Sciences Mathématiques Astronomiques et Physiques".
Ingeniøren	Ingeniøren. Address changed to: 27-31 Vester Farimagsgade, Copenhagen V.
Monthly Not. Roy. Astron. Soc. Geophys. Suppl.	Monthly Notices of the Royal Astronomical Society, Geophysical Supplement. Incorporated in the Geophysical Journal as from the end of 1957.

ERRATA

Abstr. 1823 (1958) line 3 : for "(Jan., 1958)" read "(Jan. 16, 1958).

AUTHOR INDEX

Abdullaev,G.B., 2273-4
Abragam,A., 2521, 2523
Abrikosov,A.A., 2337
Abrikosova,I.I., 2694
Agarwal,B.K., 2352
Agarwal,S.P., 2383
Agranovich,V.M., 2582
Aharoni,A., 2413
Akhiezer,A., 2477
Akhiezer,N., 2477
Albrecht,A.C., 2178, 2261
Alder,K., 2090
Alekseevskiĭ,N.E., 2253
Aliev,G.M., 2273
Alikhanov,A.I., 2552-3
Allewaert,J., 2463
Altshuler,S., 2152
Amelinckx,S., 2664
Ames,O., 2567
Amirkhanov,Kh.I., 2272
Anderson,H., 2384
Anderson,J.M., 2349
Anderson,O.A., 2596
Anderson,P.W., 2433
Andresen,A., 2642
Apanasevich,P.A., 2599
Appel,J., 2307
Arai,T., 2621
Arbman,E., 2529
Arman,A., 2091
Armstrong,A.H., 2494
Asaro,F., 2554
Ashley,L.E., 2262
Ashmore,A., 2588
Astrov,D.N., 2409
Azbel',M.Ya., 2275, 2656-7

Babb,A.L., 2256
Babiskin,J., 2338
Backus,G., 2422
Bade,W.L., 2631-3
Badgley,F.I., 2710
Bagduev,G.B., 2272
Baird,K.M., 2230
Baker,W.R., 2596
Balazs,N.L., 2280
Barloutaud,R., 2542
Baroncini,D., 2512
Barrat,J.P., 2231-2
Barrett,A.H., 2241
Barrie,R., 2321
Barrow,C.H., 2095
Barrow,G.M., 2622
Barrow,R.F., 2612
Barut,A.O., 2159
Barzilai,G., 2436
Bashshaliev,A.A., 2274
Bass,F.G., 2308
Bassett,G.A., 2706
Bauerle,J.E., 2666
Bayet,M., 2341, 2364-5
Baynham,A.C., 2665
Bazarov,I.P., 2371
Bearman,R.J., 2173, 2289
Beckel,C.L., 2609
Beckman,L., 2182
Beckman,O., 2353, 2533
Begemann,F., 2103
Behrendt,D.R., 2395
Bel,L., 2119
Belen'kiĭ,S.Z., 2153
Belov,K.P., 2339
Bennett,W., 2698
Berlin,T.H., 2580
Bernstein,H.J., 2620
Bernstein,I.B., 2432
Berry,R.S., 2611
Bertaut,E.F., 2400
Bertotti,B., 2122
Berz,F., 2305
Beuhler,E., 2653
Beyer,R.T., 2199
Bhowmik,B., 2450
Biedenharn,L.C., 2549
Bigham,C.B., 2593
Bilen'kii,S.M., 2472
Biorci,G., 2391
Birdsall,H.A., 2291
Birk,M., 2452
Birss,R.R., 2415
Bisi,A., 2532
Biswas,A.B., 2668
Biswas,S.N., 2499
Blanc,D., 2437
Blank,A.A., 2717
Block,M.M., 2511
Bloem,J., 2245
Bogdankevich,L.S., 2417
Bogoljubov,N.N., 2335
Bohm,D., 2129
Bolgiano,R., Jr, 2174
Bolotovskiĭ,B.M., 2359, 2417
Boltaks,B.I., 2675
Bonch-Bruevich,V.L., 2309
Bondi,H., 2128
Bonnor,W.B., 2116
Boreli,F., 2528
Borovik-Romanov,A.S., 2409
Borst,L.B., 2595
Bostick,W.H., 2346
Boutron,F., 2232
Bovey,L., 2224
Boyet,H., 2403
Bozorth,R.M., 2406
Bradley,D.E., 2681
Braid,T.H., 2452
Breneman,E.J., 2718
Bril',M.N., 2350
Brill,A.S., 2716
Brini,D., 2457
Brisson-Fouché,V., 2451
Brissonneau,P., 2390
Brocklehurst,R.E., 2276
Brolley,J.E., Jr, 2514, 2566
Broom,R.F., 2306
Brossel,J., 2232
Brown,G.E., 2588
Brown,L.C., 2610
Brown,L.M., 2483
Brueckner,K.A., 2278, 2515
Bubelev,É.G., 2480
Buch,T., 2171
Buckles,R.E., 2238
Bueche,F., 2629
Buechner,W.W., 2560
Buĭmistrov,V.M., 2154
Burge,E.J., 2444
Burnham,R.W., 2266
Burrus,C.A., 2239
Burton,J.A., 2325
Bŷkovskiĭ,Yu.A., 2331

Cabrera,N., 2687, 2703
Caldwell,C.S., 2256
Callaway,J., 2648
Cambieri,A., 2467
Campbell,E.C., 2537
Capps,R.H., 2151
Carnevale,E.H., 2197
Carr,T.D., 2095
Carr,W.J., Jr, 2393
Carver,J.H., 2541, 2577
Cazayus-Claverie,J., 2292
Cevolani,M., 2200
Chaban,A.A., 2536
Champion,F.C., 2462
Chapman,J.J., 2291
Charney,J.G., 2102
Cheall,H.F.K., 2612
Chesnut,D.B., 2618
Chesnut,W.G., 2505
Chidley,B.G., 2571
Chikovani,G.E., 2455
Chiu,H.-Y., 2491
Chupp,E.L., 2534
Chupp,W.W., 2504
Chuvatin,S.A., 2351
Chuvilo,I.V., 2578
Cindro,N., 2574
Cini,M., 2147, 2458
Claret,J., 2448
Clark,L.C., 2720
Class,C.M., 2531
Cloud,R.W., 2182
Cobb,C.M., 2262
Cochran,W., 2637
Coleman,R.V., 2687, 2703
Colgate,S.A., 2596
Colombani,A., 2317
Combrisson,J., 2521
Compton,W.D., 2249
Conger,R.L., 2414
Cornwell,C.D., 2619
Costa,G., 2501
Cottrell,A.H., 2669
Cowan,C.L., Jr, 2439, 2460, 2469
Cowley,J.M., 2258
Cowling,T.G., 2419
Crain,C.M., 2709
Cranberg,L., 2586
Culvahouse,J.W., 2525
Curtis,R.B., 2548
Cutkosky,R.E., 2140

Dabrowski,J., 2519
Dalgarno,A., 2367
Daniels,J.M., 2264
Danielson,G.C., 2323-4
Darden,S.E., 2528
Davies,J.H., 2444, 2450
Davies,M.O., 2700
Davies,T.V., 2102
Davies,T.V. (Conf. rep.), 2102
Davis,R.H., 2526
Davis,W.D., 2440
Davison,B., 2590
Davȳdov,A.S., 2536, 2582
Deal,W.E., 2193
Debeauvais,M., 2446
Deigen,M.F., 2661
deKlerk,J., 2188
Del Duca,M., 2700
Dell'Antonio,G.F., 2139
den Hartog,H., 2716
De Sabbata,V., 2512
Desprez-Rebaud,S., 2445
Detenbeck,R.W., 2452
DeWitt,B.S., 2162
Dicke,R.H., 2126-7
Dieke,G.H., 2233
Di Vita,S., 2291
Dolanský,L.O., 2218
Dollfus,A., 2110
Donnelly,R.J., 2281
Dougal,A.A., 2368
Dows,D.A., 2227
Duffus,H.J., 2708
DuMond,J.W.M., 2534
Durney,B., 2495
Dzyaloshinskiĭ,I.E., 2408

Eady,E.T., 2102
Egelstaff,P.A., 2640
Eisenhauer,C.M., 2641
Eisler,F., 2513
Elcock,E.W., 2674
Eldridge,J.S., 2538
Eliseev,G.P., 2552
Eliseiev,G.P., 2553
Emel'yanov,A.A., 2456
Erickson,R.A., 2286
Erickson,R.E., 2238
Érshler,B.V., 2552-3
Esaki,L., 2314
Essig,F.C., 2414
Evans,D., 2450
Evans,N.T.S., 2565
Everett,H., III, 2163

Fajans,J., 2282
Faneuff,C.E., 2257
Farkas,I., 2465
Fateev,A.P., 2359
Feher,G., 2653
Feinberg,G., 2502, 2508
Feld,B.T., 2501
Feldman,A.S., 2722
Ferraro,V.C.A., 2430
Fert,C., 2355
Fields,T.H., 2492
Fikhtengol'ts,I.G., 2155
Filmer,A.J., 2686
Fink,R.W., 2539
Finkelstein,R., 2141
Finlay-Freundlich,E., 2106
Fiorini,E., 2441
Firk,F.W.K., 2579
Firsov,O.B., 2603
Firsov,Yu.A., 2328
Fitch,V.L., 2505
Fixman,M., 2185
Flom,D.G., 2693
Foëx,G., 2410
Fomenko,B.D., 2711
Foner,S., 2404
Ford,M.A., 2236
Forrat,F., 2400
Fowler,J.F., 2290
Fowler,W.A., 2113
Fox,J.G., 2492
Fradkin,É.E., 2148
Fradkin,E.S., 2372
Franklin,A.D., 2291
French,A.P., 2565
Frisco,L.J., 2291
Frisman,É.V., 2263
Frye,G.M., Jr, 2494
Fujimura,O., 2216
Fujita,S., 2228
Fukada,E., 2290
Furth,H.P., 2596
Furuichi,S., 2487
Fuschini,E., 2457

Gaĭbullaev,F., 2299
Gall,R., 2677
Gammel,J.L., 2278, 2473, 2515
Gardner,J.W., 2347
Garnier,G.A.B., 2490
Garrett,C.G.B., 2302
Garrison,W.M., 2698
Gatto,R., 2482, 2510
Gel'likman,B.T., 2385
Geiss,J., 2103
Gerasimenko,V.I., 2656
Gere,E.A., 2653
Gerjuoy,E., 2150
Germagnoli,E., 2532
Gerosa,G., 2436
Giacconi,R., 2441
Gibbons,J.E., 2291
Gibert,R., 2287
Gilleo,M.A., 2388
Givens,M.P., 2352
Glaser,P.E., 2284
Glass,I.I., 2194
Glasser,M.L., 2648
Glick,H.S., 2630
Glubrecht,H., 2229
Goddard,K.F., 2298
Goebel,C.J., 2142
Goland,D., 2635
Goldberg,A., 2285
Goldhaber,G., 2504
Goldhaber,M., 2461
Goldhaber,S., 2504
Goldsmid,H.J., 2312
Goldstein,B., 2333
Goldstein,L., 2368-9
Goode,J.M., 2276
Goodenough,J.B., 2291
Goodman,J., 2100
Goody,R.M., 2102
Gorbatskiĭ,V.G., 2112
Gordon,F.J., 2534
Gordon,I.M., 2111
Gordon,J.P., 2653
Gordon,J.S., 2635
Gorshkov,G.V., 2568
Gorter,C.J., 2410
Gosar,P., 2191
Gottfried,K., 2573
Gottlieb,J., 2118
Gowing,D.M., 2251
Gramenitskiĭ,I.M., 2381
Granato,A., 2188, 2662
Graybeal,J.D., 2239
Grechukhin,D.P., 2563
Green,J.R., 2438
Greenberg,J., 2237
Greenspan,M., 2210
Greenwood,D.A., 2294
Gregory,D.P., 2540
Greiner,E.S., 2313
Gresky,A.T., 2115
Gribov,V.N., 2557
Griffiths,J.H.E., 2386
Grjebine,T., 2542
Grodzins,L., 2461
Guinot,B., 2092
Gulmanelli,P., 2139
Gunn,J.B., 2301
Gutowski,J.A., 2313

Halbwachs,F., 2130-2
Hall,D., 2158
Hall,J.G., 2194
Hall,J.R., 2256

all,W.S., 2566
alpern,F.R., 2643
alpern,J., 2575
ämeen-Anttila,K.A., 2121
amilton,C.W., 2291
amming,R.W., 2692
arding,S.W., 2629
argens,C.W., 2172
arris,G., 2479
arrison,W.A., 2644
art,J., 2291
art,J. (Ed.), 2291
arth,E.M., 2511
asegawa,S., 2378
ass,G., 2252
attori,S., 2216
awkins,G.S., 2101
ayashi,C., 2135
ayes,W., 2613, 2659
ead,A.K., 2221
eber,G., 2416
eer,C.V., 2286
eisenberg,W., 2134
enry,G.E., 2207
errmann,G., 2189
erschbach,D.R., 2606
ess,D.C., 2103
ester,R.E., 2559
eymann,H., 2589
ibdon,C.T., 2584
ide,R., 2102
iebert,G.L., 2667
iguchi,J., 2624
ikata,A., 2662
ildreth,K.M., 2720
ill,R.W., 2587
illion,P., 2464
ilsum,C., 2321, 2334
oang Pham Tan, 2120
oerni,J.A., 2329
offman,J.D., 2291
ogarth,C.A., 2665
olm,D.M., 2585
opkins,I.L., 2692
ornig,D.F., 2667
ovorka,F., 2700
oward,P.R., 2373
oward,R.E., 2340
owe,H.A., 2561
owland,L.P., 2645
rostowski,H.J., 2326
uang,K., 2486
ughes,D.J., 2641
ulme,K.F., 2725
ultgren,R., 2285
unter,A.N., 2201
unter,W.R., 2252
unting,C.E., 2569
urley,A.C., 2625
utchison,T.S., 2686
utton,G.J., 2686

en,I., Jr, 2551
o,G., 2504
akovac,K., 2574
gard,U., 2202-3
ffe,B.L., 2592
ani,K.S., 2668
edale,P., 2555
e,J., Jr, 2596
ted,G.A., 2714
anchuk,V.I., 2420

.cob,K.C., 2199
nssen,S., 2295
nes,D.A., 2659
nes,L.H., 2226
pson,R.C., 2534

aganov,M.I., 2275, 2308
Kaiser,R.H., 2326
Kallmann,H., 2250
Kane,J.A., 2492
Känzig,W., 2654
Kapany,N.S., 2219
Kaplan,S.N., 2562
Kasper,J.S., 2407
Katz,L., 2571-2
Kaufman,A.N., 2421
Kaus,P.E., 2304
Kazhlaev,M.A., 2272
Keck,P.H., 2175
Kedesdy,H., 2175
Keim,R.E., 2219
Keinath,G., 2170
Kerner,E.H., 2157
Khalatnikov,I.M., 2279
Khashaba,S., 2600
Khoklov,R.V., 2435
Khvashchevskaya,Ya.S., 2235
Kikoin,I.K., 2331
Kimball,G.E., 2623
King,H.J., 2572
King,K.A., 2291
Kinman,T.D., 2109
Kirkwood,J.G., 2173, 2176 2632
Klein,M.P., 2615
Kleitman,D., 2672
Klimontovich,Yu.L., 2435
Klinger,M.I., 2310
Kobzarev,I.Yu., 2489
Koehler,J.S., 2666
Koester,C.J., 2254
Kolesnikov,N.N., 2601
Kondo,J., 2387
Kopal,Z., 2102
Korn,T.S., 2217
Kornienko,L.S., 2658
Kovács,I., 2616-17
Kovásznay,L.S.G., 2091
Kowalski,S., 2571
Kozhevnikov,N.I., 2107
Kraichnan,R.H., 2426
Krishnaji, 2243
Kristiansson,K., 2500
Krivoglaz,M.A., 2676, 2679
Krohn,V.E., 2520
Kronsbein,J., 2123
Kruse,H.W., 2469
Kryder,S.J., 2628
Kuffel,E., 2370
Kulikovskiĭ,A.G., 2418
Kumar,R.C., 2449
Kurdgelaidze,D.F., 2149
Kuroda,K., 2564
Kurov,P.A., 2680

Laborde,G., 2108
Lal,S., 2376
Lamb,G.L., Jr, 2202
Lamb,J., 2209
Lamb,W.A.S., 2559
Landsberg,P.T., 2322
Landsman,D.A., 2540
Lapidus,L.I., 2471
Larsson,K.E., 2277
Lasinio,G.J., 2475
Launay,J., 2316-17
Lax,M., 2650
Lazar,N.H., 2583
Lebenbaum,M., 2100
Lebowitz,J.L., 2168
LeCraw,R.C., 2402
Lee,L.L., Jr, 2526-7
Lee,T.D., 2486
Lee-Whiting,G.E., 2547
Legallais,V., 2716
Le Gentil,M.C., 2445
Legge,R.D., 2201
Legvold,S., 2395-6
Lehmann,P., 2542
Lehovec,K., 2300
Leigh,R.S., 2636
Lessing,N.v.d.W., 2269
Lévêque,A., 2542
Levin,J.S., 2586
Lewis,R.R., 2548
Libowitz,G.G., 2626
Lide,D.R., Jr, 2242
Lidiard,A.B., 2340
Lifshits,I.M., 2275, 2656-7
Lifshitz,J., 2377
Lindenbaum,S.J., 2493
Lindström,G., 2589
Lin'kov,E.M., 2684
Lipkin,H.J., 2517
Litovitz,T.A., 2197
Lochak,G., 2156
Logan,R.A., 2705
Logunov,A.A., 2498
Logunov,V.N., 2354
Lokan,K.H., 2576
Long,D., 2327
Longmire,C.L., 2270
Looms,J.S.T., 2344
Lorenz,E., 2102
Lubimov,V.A., 2553
Luborsky,F.E., 2389, 2401
Lücke,K., 2662
Lüders,G., 2482
Lunnutti,J.E., 2504
Luyten,J.R., 2485
Lynn,J.E., 2579
Lyon,W.S., 2538, 2583
Lyubarskiĭ,G., 2477
Lyubimov,V.A., 2552

McCallum,G.J., 2640
McCarvill,P.D., 2613
McCombie,C.W., 2674
McConnell,H.M., 2618, 2697
McCullough,T.P., 2096-7
McDiarmid,I.B., 2591
MacDonald,D.K.C., 2167
Mack,S.Z., 2707
Macklin,R.L., 2583
McLean,E.A., 2257
McMillan,J.A., 2171
McReynolds,A.W., 2642
McSkimin,H.J., 2685
Magee,J.B., 2709
Maire,F., 2722
Makin,M.J., 2688
Malitson,I.H., 2222
Mandel,M., 2241
Mandzhavidze,Z.Sh., 2455
Mann,D.E., 2242
March,N.H., 2161
Margem,N., 2490
Margenau,H., 2348
Marguin,G., 2443
Marion,J.B., 2113
Mark,H., 2534
Marongiu,N., 2447
Marques,A., 2490
Marshak,R.E., 2468
Martin,A., 2136
Maryott,A.A., 2628
Mason,E.A., 2186, 2634
Massey,H.S.W., 2600
Matsukawa,E., 2201
Matthews,P.T., 2138
Matthias,B.T., 2406
Matvienko,V.I., 2568
Mayer,C.H., 2096-7
Mazo,R.M., 2176, 2476
Meeron,E., 2177
Mendelsohn,L.I., 2401
Menes,M., 2660
Menter,J.W., 2706
Merrifield,R.E., 2646
Meshkovskiĭ,A.G., 2497
Meyer-Berkhout,U., 2531
Milford,S.N., 2459
Millburn,G.P., 2562
Miller,C.E., 2704
Mills,A.W., 2723
Minami,S., 2228
Minnis,C.M., 2104
Mirsky,I., 2189
Misrahy,G.A., 2720
Mitshuishi,A., 2228
Miyakawa,K., 2683
Mizushima,M., 2240
Moeller,C.W., 2411
Moliner,F.G., 2652
Moneti,G.C., 2475
Montgomery,D.J., 2297
Moodie,A.F., 2258
Moran,T.I., 2179
Morand,M., 2445
Mori,H., 2187
Morita,M., 2545, 2550
Morita,R.S., 2545, 2550
Morris,R.G., 2323-4
Morris,R.H., 2267
Morrison,P., 2093
Motley,R.M., 2505
Moussa,A., 2544
Moxon,M.C., 2579
Moyer,B.J., 2562
Moyer,H.C., 2699
Mühleisen,R., 2712
Mullin,J.B., 2725
Mungall,A.G., 2291
Murakami,H., 2265
Murphy,F.V., Jr, 2222

Nagy,K., 2465
Nanney,C.A., 2257
Naranan,S., 2376
Nauenberg,M., 2509
Neher,H.V., 2384, 2724
Nelkin,M., 2642
Nelson,F., 2537
Nelson,R.C., 2726
Nemirovskiĭ,P.É., 2518
Nesbet,R.K., 2160, 2516
Nettleton,R.E., 2180
Neuert,H., 2589
Nevin,T.E., 2613
Newns,H.C., 2558
Nilsson,S.G., 2556
Nishimura,J., 2378
Nishimura,Y., 2378
Nordhagen,R., 2588
Nozières,P., 2655
Nyborg,W.L., 2190

Oatley,C.W., 2184
Odziemczyk,J., 2598
Oetjen,R.A., 2228
Ogawa,T., 2206
Ogilvie,K.W., 2374
Oleson,S.K., 2203
Ôno,K., 2564
Oppenheim,A.K., 2715
Orear,J., 2479
Orlova,M.P., 2409
Orr,R.L., 2285
Otnes,K., 2277
Ovchinnikov,E.P., 2354
Owen,G.E., 2567, 2580
Owen,J., 2386

Paine,T.O., 2401
Palevsky,H., 2277, 2641
Palinchak,S., 2291
Panofsky,W.K.H., 2505
Pappalardo,R., 2467
Park,J.G., 2386
Parker,E.N., 2425
Parker,P.M., 2610
Partridge,M.F., 2386
Patskevich,V.M., 2357
Pauli,R., 2277
Pavlikovskiĭ,A., 2166
P čijare,O., 2295
Peck,E.R., 2223
Ped'ko,A.V., 2339
Peirson,D.H., 2555
Pekar,S.I., 2154
Pelah,I., 2641
Peli,L., 2457
Penfield,R.H., 2146
Penning,P., 2677
Pensak,L., 2332
Pepple,R., 2095
Perlman,I., 2554
Person,W.B., 2238
Pescetti,D., 2391
Peters,A.J., 2705
Peterson,A.W., 2175
Petralia,S., 2200
Petro,A.J., 2291
Pettus,W.G., 2466
Petukhova,N.I., 2507
Pham Tan Hoang, 2120
Picciotto,E., 2446
Pickett,J.M., 2211-13, 2215
Picou,J.L., 2542
Pinkau,K., 2379
Pipkin,F.M., 2525
Pippard,A.B., 2651
Pitt,D.A., 2291
Plachenov,B.T., 2675
Plano,R., 2513
Plebanskiĭ,G.I., 2506
Pligin,Yu.S., 2497
Plumlee,R.H., 2361
Plumpton,C., 2430
Podgornyĭ,I.M., 2351
Pollack,I., 2211-12, 2214-15
Pollak,M.J., 2204
Pomerantz,M.A., 2383
Pontekorvo,B., 2478
Pople,J.A., 2620
Popper,B., 2183
Post,D., 2255
Potapov,E.V., 2253
Potnis,V.R., 2383
Potter,R.F., 2319
Poulet,H., 2604
Pradal,F., 2355
Pradhan,T., 2431
Prakash,S., 2724
Price,B., 2687
Price,W.C., 2236
Prior,A.C., 2318
Proctor,W.G., 2523
Prokhorov,A.M., 2658
Prosser,F.W., Jr, 2526
Prowse,D.J., 2444, 2450
Pyle,R.V., 2596

Rabinowicz,E., 2695
Raboy,S., 2520
Ramanamurthy,P.V., 2376
Ramsey,N.F., 2145
Rasmussen,J.O., 2546, 2556
Rathenau,G.W., 2399
Ravenhall,D.G., 2504
Redin,R.D., 2323-4
Refai,M.Y., 2558
Regel',A.R., 2299
Reid,W.H., 2429

Reiner,M., 2183
Reines,F., 2439, 2460, 2469
Reitz,D.C., 2614
Rhodes,B.L., 2396
Rice,E.A., 2720
Richardson,W.H., 2260
Rider,J.A., 2291
Rietdijk,J.A., 2283
Riety,P., 2208
Ritow,H., 2342-3
Robin,L., 2089
Robinson,C.F., 2360
Robson,B.A., 2570
Rocard,J.M., 2453
Rodberg,L.S., 2144
Rodney,W.S., 2222
Rodot,M., 2315
Rogers,E.J., 2358
Roĭnishvili,N.N., 2455
Ronzio,A.R., 2439
Rorschach,H.E., 2549
Rosen,L., 2514, 2566
Rosenbluth,M.N., 2421, 2642
Ross,J., 2187
Rothstein,J., 2181
Rozental',I.L., 2456
Rubin,H., 2722
Rubinshteĭn,L.I., 2288
Rudnick,I., 2198
Rusanov,V.D., 2354
Rŷndin,R., 2470

Sachs,M., 2647
Sahiar,A.B., 2376
Sakamoto,M., 2621
Sakurai,J.J., 2137
Salam,A., 2138
Salpeter,E.E., 2594
Samios,N., 2513
Sandler,Y.L., 2412
Sandström,R., 2533
Sawada,S., 2487
Sawyer,J.S., 2102
Saxena,S.C., 2186
Scarf,F.L., 2143
Scherrer,V.E., 2257
Schiffer,J.P., 2526-7
Schlivitch,S., 2246
Schlueter,D.J., 2223
Schmied,H., 2539
Schneider,W.G., 2620
Schoeni,K., 2300
Schreckendgust,J.G., 2251
Schwartz,J., 2454
Schwartz,M., 2513
Schwarz,E., 2175
Schwendeman,R.H., 2608
Seeds,W.E., 2236
Seidel,H., 2403
Seiden,J., 2522
Seitz,F., 2666
Sekiguchi,T., 2369
Serson,P.H., 2707
Servant,R., 2292
Severnŷĭ,A.B., 2105
Shafranov,V.D., 2196, 2427
Shain,C.A., 2094
Shalamov,Ya.Ya., 2497
Shand,J.A., 2708
Shaw,E.A.G., 2719
Shcherbakova,M.N., 2381
Shchuruvna,V., 2166
Shebanov,V.A., 2497
Shenker,H., 2405
Sheppard,P.A., 2102
Shevchenko,V.G., 2578
Shiffman,C.A., 2271
Shimada,J., 2564
Shinabarger,E.W., 2720
Shirley,V.S., 2546
Shotov,A.P., 2330
Shtrikman,S., 2413
Siebenmann,P.G., 2338
Siegel,S., 2607
Sigal,M.I., 2098
Signell,P.S., 2468
Singh,S., 2169
Sinha,A.P.B., 2668
Sitnik,G.F., 2225
Skurnik,E., 2363
Slaughter,G.G., 2511
Sloanaker,R.M., 2096-7
Smirnitskiĭ,V.A., 2488
Smirnov,L.S., 2357
Smith,A.G., 2095
Smith,D.O., 2291
Smith,D.S., 2230
Smith,J.H., 2311
Smits,L.J., 2410
Smoke,E.J., 2291
Smorodinskiĭ,Ya.A., 2470
Snieder,J., 2397-8
Snow,A.I., 2699
Snyder,D.D., 2297
Soderman,R.A., 2291
Sodha,M.S., 2303
Solomon,I., 2521
Solov'ev,L.D., 2481
Soroko,L.M., 2496
Spedding,F.H., 2395-6
Spencer,E.G., 2402
Sperduto,A., 2560
Spit,B.J., 2681
Spitzer,L.,Jr, 2423
Srivastava,G.P., 2243
Stakhanov,I.P., 2192
Stakutis,V.J., 2713
Stallwood,R.A., 2492
Stapp,H.P., 2503
Staryi,I.B., 2350
Steckelmacher,W., 2184
Stedman,R., 2277
Steinberg,M.S., 2649
Steinberger,J., 2513
Stekolnikov,I.S., 2345
Stepanov,B.I., 2235, 2599
Stephens,F.S.,Jr, 2554
Sternheimer,R.M., 2493
Stevenson,A.F., 2259
Stewart,L., 2566
Stiegler,K., 2124
Stone,R.S., 2597
Stott,F.D., 2702
Stratonovich,R.L., 2165
Street,R., 2311
Stroffolini,R., 2458
Stroh,A.N., 2690
Strutinskiĭ,V.M., 2535
Stupochenko,E.V., 2192
Sturm,W.J., 2296
Subramanian,A., 2376
Succi,C., 2441
Suchow,L., 2394
Sucov,E., 2250
Suhl,H., 2392
Sundheim,B.R., 2237
Sunyar,A.W., 2461
Surkov,Yu.A., 2543
Sutcliffe,R.C., 2102
Sutton,R.B., 2492
Svensson,N.L., 2689
Sverdrup,H.U., 2102
Sveshnikov,B.Ya., 2247
Sweeny,R.F., 2696
Synge,J.L., 2125

Tabor,W.J., 2605
Tai,Y.-K., 2562
Tan Hoang Pham, 2120
Tanaka,S., 2564
Tárczy-Hornoch,A., 2268
Tavernier,J., 2639
Tavkhelidze,A.N., 2498
Taylor,H.E., 2293
Taylor,S., 2479
Taylor,W.J., 2627
Telegdi,V.L., 2483
Teodorovich,É.V., 2602
Terrell,J., 2585
Thaler,R.M., 2473, 2504
Thekaekara,M., 2233
Thiessen,G.J., 2719
Thomas,P.M., 2612
Thompson,N., 2691
Thurmond,C.D., 2653
Tidman,D.A., 2374
Tiemann,J.J., 2504
Tietz,T., 2598
Tolhoek,H.A., 2485
Toolin,R.B., 2713
Touschek,B., 2147
Tousey,R., 2252
Tousset,J., 2544
Tozer,B.A., 2366
Trehan,S.K., 2424, 2428-9
Tret'yakova,M.I., 2381
Trittipoe,W.J., 2721
Truell,R., 2188
Trulio,J.G., 2623
Trump,J.G., 2182
Tsai-Chü, 2448
Tschiegg,C.E., 2210
Tsujiuchi,J., 2220
Turchinetz,W., 2541, 2577
Tuzzolino,A.J., 2320
Tyler,J.E., 2260

Umezawa,H., 2143
Urey,H.C., 2102

Vaĭnshteĭn,É.E., 2350
Vaĭsenberg,A.O., 2488
Valatin,J.G., 2336
Valentine,R.C., 2682
Valstar,A., 2283
Van de Plas,R., 2217
Vanderslice,J.T., 2634
Van de Walle,R., 2463
van Gool,W., 2248
Van Heerden,I.J., 2444
Vassamillet,L.F., 2276
Vavilov,P.V., 2442
Vavilov,V.S., 2357
Verhaeghe,J., 2463
Verlet,L., 2581
Veronesi,P., 2457
Vescan,T.T., 2117
Vigier,J.P., 2129
Vinetskiĭ,V.L., 2661
Vitkevich,V.V., 2098
Vladimirskiĭ,K.V., 2524
v.Friesen,S., 2500
Vook,R., 2673
Vul,B.M., 2330

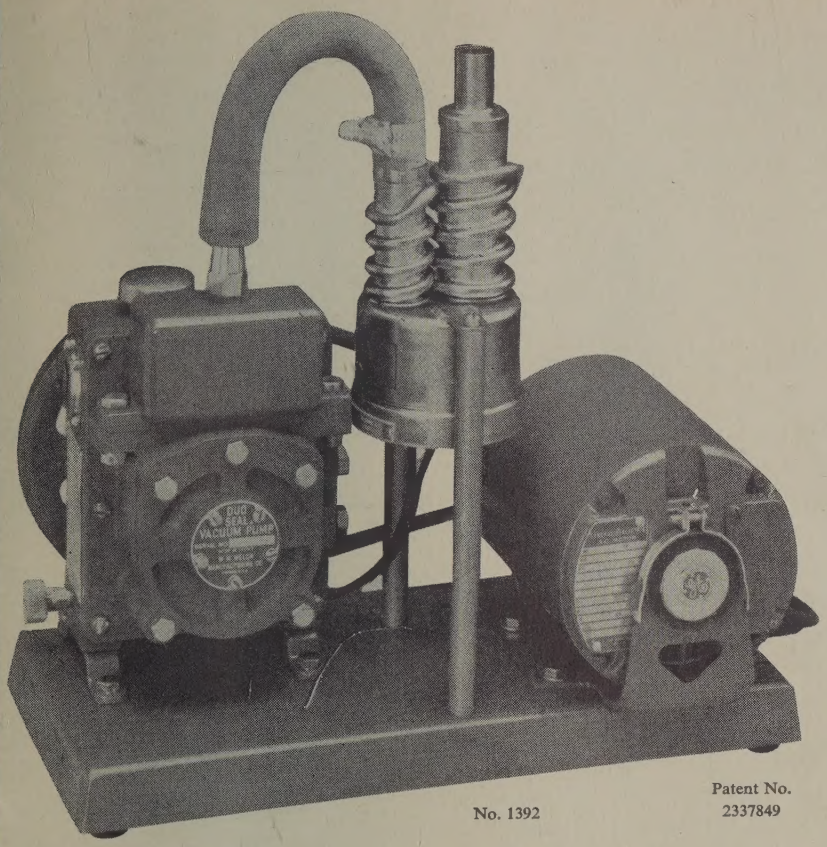
Wada,M., 2382
Waddington,C.J., 2375
Wadsworth,N.J., 2691
Wahlborn,S., 2530
Waite,T.R., 2671
Walker,R.E., 2701
Wall,N.S., 2569
Ward,J.O., 2698
Ward,R.L., 2615
Waters,P.M., 2362
Waterstrat,R.M., 2407
Watson,W.W., 2179
Weber,J., 2434
Wechsler,M.S., 2296
Weeks,B.M., 2698
Weil-Marchand,A., 2244
Weissman,S.I., 2614
Wert,C., 2673
Wesemeŷer,H., 2264
West,E.J., 2249
Westenberg,A.A., 2701
Whapham,A.D., 2663
Wheeler,J.A., 2164
Whetstone,A., 2575
Whitham,K., 2707
Whittemore,W., 2642
Wightman,A.S., 2158
Wigner,E.P., 2133
Wilgain,S., 2446
Wilkinson,G.R., 2236
Williams,J., 2209
Winther,A., 2090
Witte,H., 2638
Wittels,M.C., 2670
Wölfel,E., 2638
Wolfenstein,L., 2484
Woodruff,T.O., 2654
Wright,P., 2298
Wright,R.E., 2596
Wurster,W.H., 2234, 2630

Yamada,Y., 2228
Yamaguchi,S., 2356
Yamamoto,K., 2216
Yamamoto,S., 2678
Yamasaki,R.S., 2619
Yamashita,J., 2387
Yang,C.N., 2486
Yeager,E., 2700
Yearian,H.J., 2672
Yonezawa,M., 2487
Yoon,T.S., 2380
Yoshinaga,H., 2228
Young,O.B., 2380
Young,R.W., 2205
Young,W.H., 2161

Zappa,L., 2532
Zatzkis,H., 2146
Zeeman,P.B., 2612
Zel'dovich,Ya.B., 2195
Zemach,A.C., 2476
Zharkov,V.N., 2279
Zhdanov,G.B., 2381
Zimin,A.G., 2474
Zozulya,Yu.I., 2310
Zuleeg,R., 2300
Zwislocki,J., 2722

DUO-SEAL MECHANICAL AND DIFFUSION PUMP ASSEMBLY

(R) EACH ELEMENT WITH TWO-STAGE CONSTRUCTION



No. 1392

Patent No. 2337849

Guaranteed Vacuum
0·001 micron
(0.000 001 mm Hg)

Capacity at 0·1 micron
600 liters/minute

No. 1400B Mechanical Pump
All-Metal Diffusion Pump
Heater Incorporated in Pump
No Additional Heat Needed
Diffusion-Pump Oil Furnished
(150 ml Octoil)
Extra Supply of Duo-Seal Oil

WATER-COOLED OR
AIR-COOLED MODELS

$275.00
Complete with Motor

This is an unusually convenient portable diffusion-pump unit, employing a two-stage mechanical pump and an unbreakable, all-metal diffusion pump. The two components are properly matched as to performance and together will produce a vacuum of better than 10^{-6} mm. quietly and rapidly without the use of a cold trap. The unit is supplied ready to put into service, complete with oil for both pumping elements.

Other combinations are available with speeds of 120 to 6000 liters per min. at 0·1 micron. We will gladly submit full details describing the best combination for your particular application.

1392. MECHANICAL AND DIFFUSION PUMP, Water-Cooled.
For 115 Volts, 60 Cycles, A.C. — Each, $275.00

1392A. MECHANICAL AND DIFFUSION PUMP, Air Cooled.
For 115 Volts, 60 Cycles, A.C. — Each, $275.00

For attached Belt Guard, add $15.00 to above prices.

1391. DIFFUSION PUMP, Only, Water Cooled, With Octoil. Each, $100.00

1394. DIFFUSION PUMP, Only, Air Cooled With Octoil. Each, $100.00

1393. MOUNTING PARTS.
For mounting No. 1391 or No. 1394 Diffusion Pump on base of mechanical pump. Set, $3.00

WRITE FOR OUR COMPLETE BOOKLET ON VACUUM PUMPS AND VACUUM TECHNIQUE.

W. M. WELCH SCIENTIFIC COMPANY

DIVISION OF W. M. WELCH MANUFACTURING COMPANY

Established 1880

1515 Sedgwick St. Dept. PA. Chicago 10, Ill. U.S.A.

Manufacturers of Scientific Instruments and Laboratory Apparatus.

FERRANTI

CERAMIC TO METAL SEALS

Ferranti Ceramic to Metal Seals have been developed to overcome the limits imposed upon valve performance by the use of conventional glass to metal seals. They perform so successfully that uses are apparent in other fields, particularly as terminals for vacuum and pressure vessels operated at elevated and sub-normal temperatures.

CHARACTERISTICS

Operating Temperature	intermittent 700°C maximum. continuous 300°C - 450°C dependent on atmosphere.
Operating Pressure	at least 100 atmospheres, depending on direction of compression.
Mechanical Strength	shearing force = 2,500 lbs per square inch of seal area.
Electrical Insulation	breakdown voltage in air is greater than 24 kV per inch of ceramic between seals.
Leakage Resistance (Typical)	10^{13} to 10^{15} ohms, at room temperature between two metal rings separated by 0·3″ of clean ceramic surface on a seal 0·440″ in diameter.
High Frequency Performance (Typical)	loss of 56 watts when 1 kW C.W. is passed through a seal incorporated in a ceramic-filled X-band circular wave-guide.

APPLICATIONS

The mechanical and electrical properties listed above suggest a wide variety of uses, a few of which are given below :-

Microwave and ordinary valve envelopes.
Semi-conductor envelopes.
Terminations for single and multicore cables.
Terminals and leads for vacuum and pressure vessels in atomic energy projects.
Thermocouple seals for furnaces.

FERRANTI

FERRANTI LTD · GEM MILL · CHADDERTON · OLDHAM · LANCS

London Office: KERN HOUSE, 36 KINGSWAY W.C.2.

FE 181